FEBRUARY 1956 • $1.00

GAS

FUNDAMENTALS of GAS MIXING

A dispatcher's view of turbine compressor stations

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STANDARD EQUIPMENT ON ALL "EI" SERIES REGULATORS

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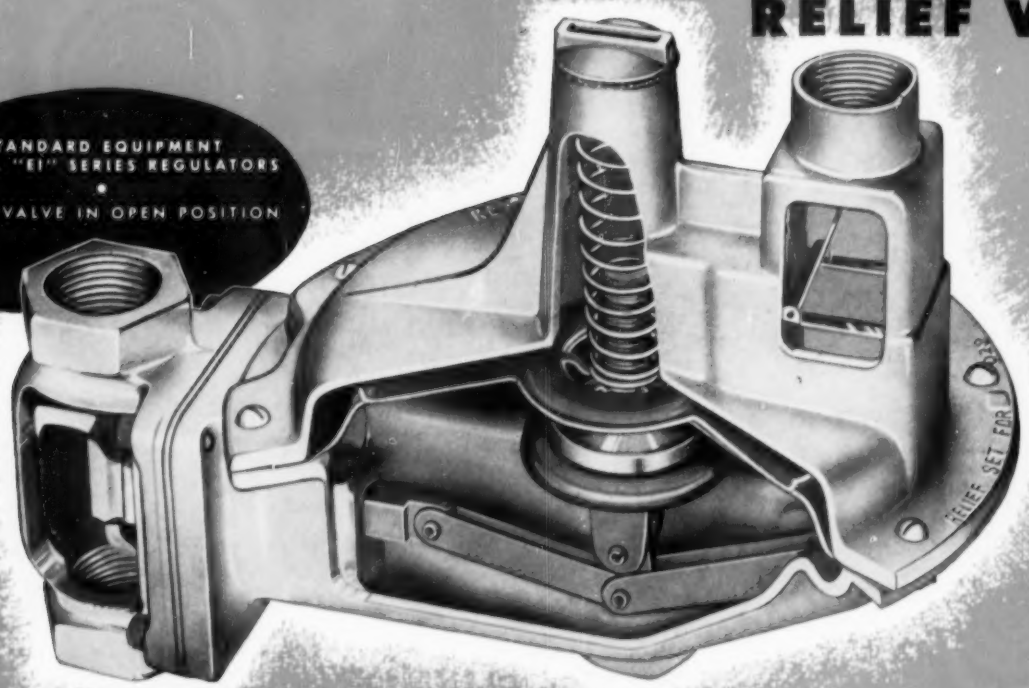

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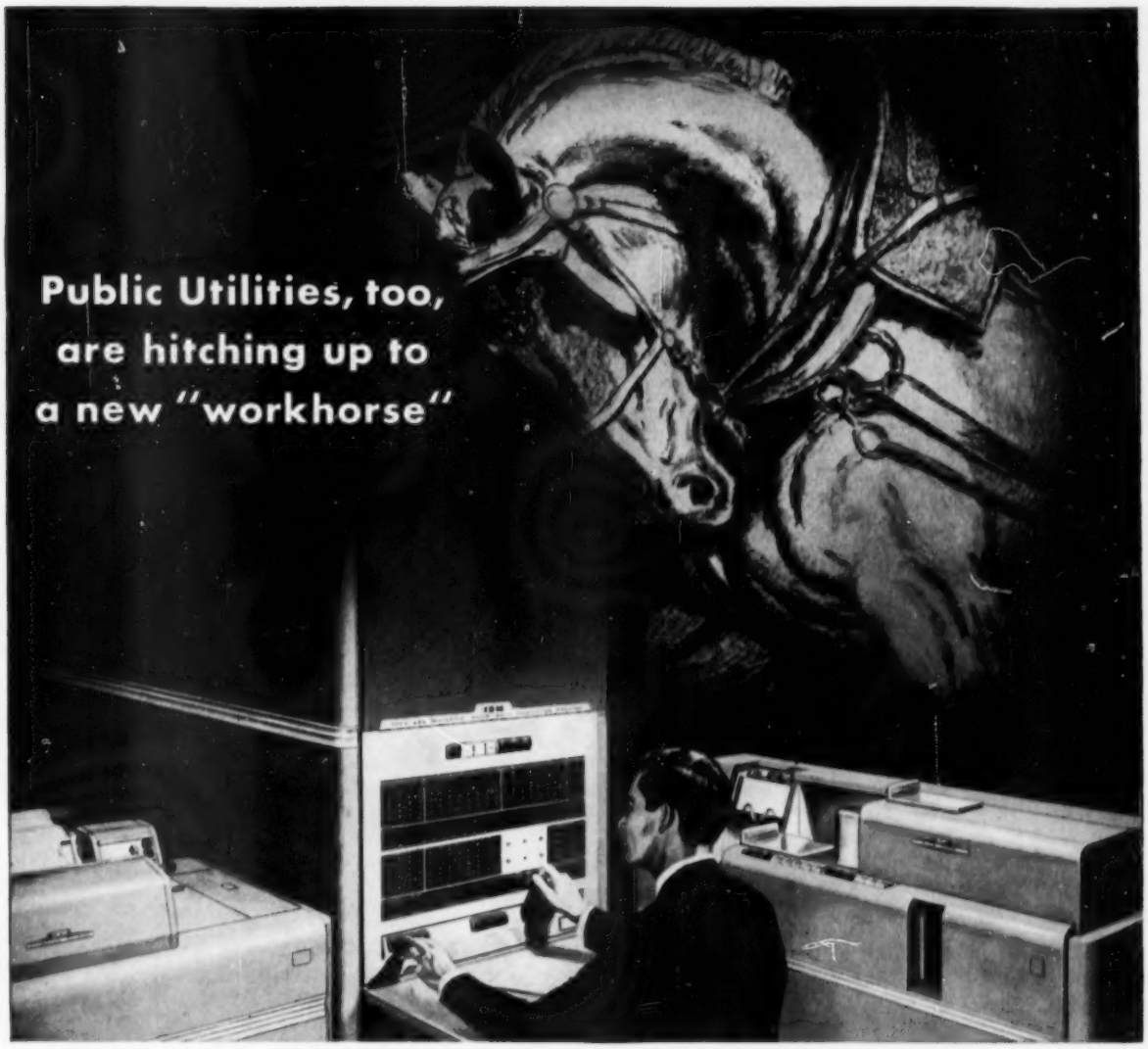

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GAS

32nd YEAR OF PUBLICATION

IN THIS ISSUE . . . .

The technology of gas mixing and control of the mixing process have developed in importance as the industry has progressed. A series starts this month that will describe the latest techniques that can aid the utilities who use supplemental fuels for peak use, peak shaving, and standby operations, (pages 37 - 40). Operating experience with combustion gas turbines means more than countless predictions of their value to the industry. On page 109, a dispatcher tells his experience with these relatively new power units.

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Pressures to 125 p.s.i.

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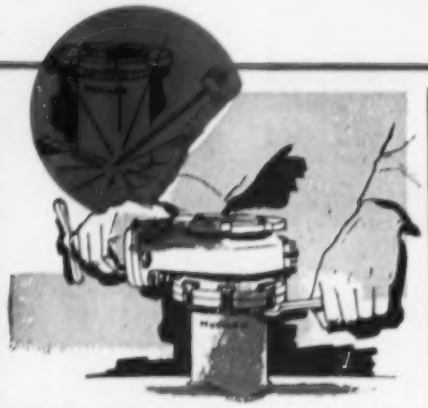
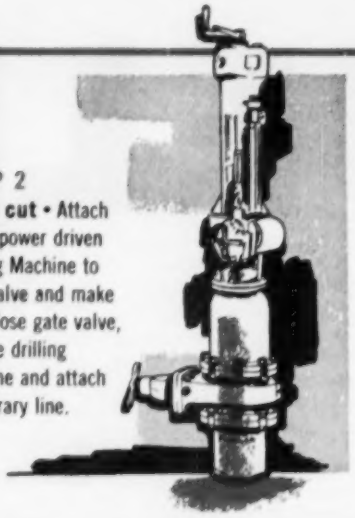
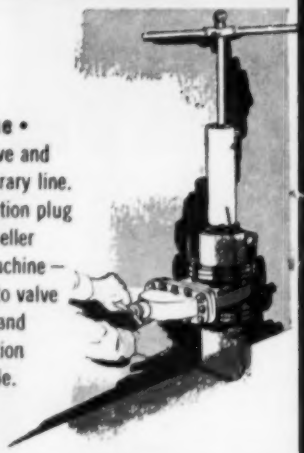


STEP 1—**Weld** • Position and weld nipple to line or tank. Remove inner completion plug, attach test cap and pressure test. Remove test cap and attach and open Mueller gate valve.



STEP 2
Make cut • Attach C1-36 power driven Drilling Machine to gate valve and make cut. Close gate valve, remove drilling machine and attach temporary line.

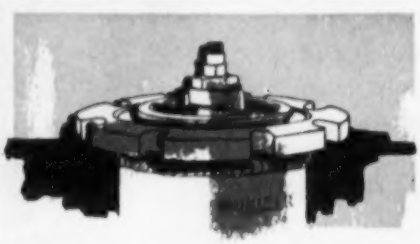


STEP 3
Abandon line • Close gate valve and remove temporary line. Attach completion plug to shaft of Mueller Completion Machine — bolt machine to valve — open valve and screw completion plug into nipple.

Recover valves from temporary connections

Mueller Save-A-Valve Drilling Nipples permit you to recover the gate valve when abandoning temporary connections. The exclusive No-Blo® Completion Plug with "O" ring seal and pressure equalizing valve is inserted into the drilling nipple through the gate valve. Screwed tightly into inside threads, the completion plug holds the pressure – permits you to recover the valve for other uses. A flanged completion cap provides a double seal against leakage. The flanged type nipple has a welding inlet contoured to fit the pipe. Available in sizes 4", 6" and 8" with 150 pound flanges for pressures to 230 p.s.i. Optional 300, 400 and 600 pound flanges on the 4" and 6" sizes withstand pressures up to 1200 p.s.i. Smaller nipples in sizes ¾" through 3" are available with welding or threaded inlets – pressures to 1200 p.s.i.

STEP 5—**Cap nipple** • Tighten plug with wrench provided. Place gasket in flange recess of nipple. Bolt cap tightly to nipple. Recovery of gate valve is now complete.



STEP 6—**Re-use fitting** • Remove cap and loosen plug with wrench. Attach extracting tool to plug. Bolt gate valve to nipple and completion machine to valve. Advance shaft to engage extracting tool — unscrew plug and remove through gate valve. Close valve, remove equipment and attach temporary line.

Contact your Mueller Representative for additional information on other Mueller No-Blo equipment that makes connections safely, without escape of gas.

MUELLER CO.
Dependable Since 1857
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STEP 4 — Recover valve • Remove Completion Machine and gate valve.
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NO-BLO
Method

GAS Thermally Thinking

Annual survey previewed

SEVERAL days ago we asked our research department for a preview of the responses received to date from our annual survey of gas industry construction budgets, and it looks as if the industry is headed for another all-time high in construction and expansion activity during 1956. So far we've received about 25% return on the survey and indications are that 1956 budgets will run between 10% and 12% over last year.

Each year at about this time we anxiously look to the returns of the survey for an indication of the industry's overall health and its outlook for the future. It is, indeed, interesting to watch programmed expansion and construction projects pile up, and to play with an analysis of the reasons behind trends that seem to develop and fade.

The confidence of the industry, along with its collective opinion toward certain types of products, techniques, and services is no more obvious than in its statement of planned expenditures for the year. It is for this reason that we take great care in preparing our predictions of industry growth for the year.

Based on our early returns, this year's estimate will again have well over $1 billion earmarked for new construction and the expansion of existing facilities. In addition, it is indicated that there is a distinct possibility that total industry expenditures will equal or exceed 1951's record of $1.4 billion.

Taking a look at some of the specific items, it is interesting to note that:

- Distribution company budgets may be up more than the estimated industry-wide average of 12%, to nearly 15%.
- Several companies make the comment that their 1956 budgets are the "largest ever."
- Up-grading of existing transmission lines through replacing with larger pipe, looping, and increasing compressor horsepower is yearly consuming a larger share of all transmission expenditures.
- Changeover programs engendered by last year's transmission construction will be big items in distribution budgets for 1956, particularly in the Pacific Northwest.
- There is a noticeable increase in industry budget allotments for the construction of new office and service buildings.

Even from this more or less sketchy report, what better evidence is there that the gas industry will continue to be "the country's fastest growing industry?"

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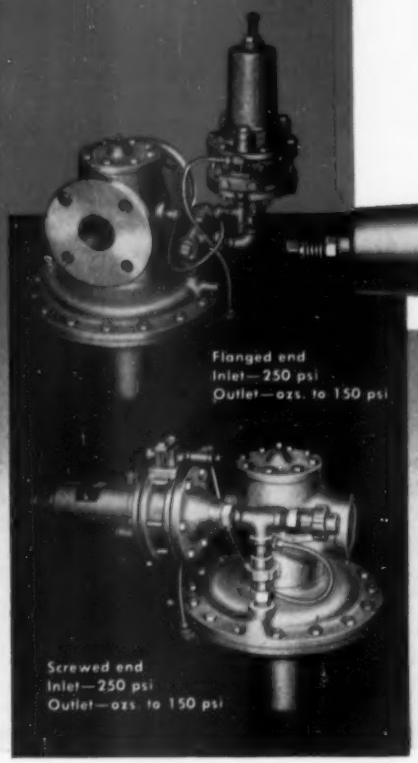
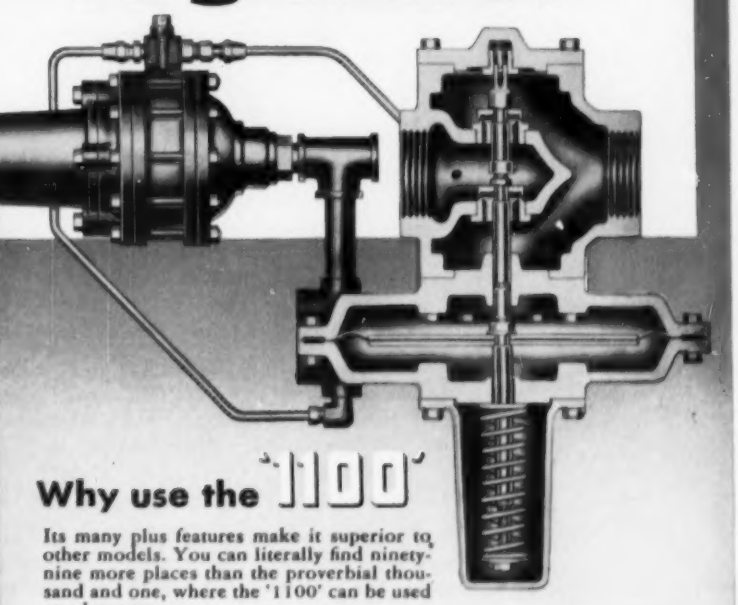
Chaplin-Fulton '1100' regulator

why?





Why use the '1100'

Its many plus features make it superior to other models. You can literally find ninety-nine more places than the proverbial thousand and one, where the '1100' can be used to advantage.

One basic assembly-2"-screwed or flanged.

- **WIDER APPLICATION**—inches water to 150 psi controlled pressure—means less different types to stock and service.
- **GREATER CAPACITY**—balanced valve construction passes 114,000 CFH at 100 psi to ounces—replaces larger costlier regulators to reduce cost of whole installation.
- **PROVEN PERFORMANCE**—straight line control from minimum to maximum flow. Stable operation on quick changing loads, or with on-and-off controls. Fast low lock-up on zero flow.
- **SIMPLER CONSTRUCTION**—no intricate parts or delicate adjustments. All wearing parts easily replaced. Regulator or pilot can be serviced without disturbing the other.
- **EASIER INSTALLATION**—compact design requires little space for installation in any position. Just place in line and make one connection from regulator to outlet line.

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Bulletin 1100 with complete information sent on request.

54-1100

highlights

GAS — SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Court's fair field price decision to be appealed

FPC will appeal the adverse fair field price decision rendered by the U. S. court of appeals for the District of Columbia (January GAS, p. 132) in the long drawn-out Panhandle Eastern rate case. Although the court didn't outlaw the commission's fair field price concept, it did say that if fair field price is used, it must relate to a rate base-rate of return-cost of service approach, which must be advantageous to the ultimate consumer.

Westcoast line to Pacific Northwest under way

Construction of the 650-mile line of Westcoast Transmission Co. Ltd. got underway last month when crews of Canadian Bechtel Ltd. began clearing the 60-ft right-of-way for the $152 million line to carry gas to the international border in Washington to connect with Pacific Northwest Pipeline Corp.'s line. Construction is being speeded to meet—or better—the schedule which calls for completion in the fall of '57.

TGT will build 200-mile L. P. gas pipeline

Plans for the construction of a 200-mile LPG pipeline, a $2 million separation plant and storage and handling facilities were revealed by Tennessee Gas Transmission during negotiations with the Houston Navigation District port commission to purchase about 50 acres along the ship channel for the separation plant. Expansion is planned to meet demands of the Petro-Tex Chemical Corp. plant in Houston.

Gas industry construction budgets may set all-time high

The country's fastest growing industry will continue at an even faster clip during 1956, on the basis of early returns from GAS' annual survey of gas industry construction. With about 25% of the survey in and tabulated, gas industry construction budgets for the year are running over 10% ahead of last year for what may result in a new all-time high for the industry.

Trans-Canada's 1956 construction date appears doomed

Financing and construction of the Trans-Canada project depends on U. S. Approval of the agreement between Tennessee Gas Transmission Co. and Trans-Canada Pipe Lines Ltd. for export at Emerson, Manitoba, to TGT's projected midwestern line, and most observers believe that the proposal will be the most complicated and controversial legal battle in the history of the FPC—and probably the longest. Critical date for the joint project is May 1, 1956. If Trans-Canada hasn't fulfilled its part of the bargain by then, the Canadian government is pledged to "reconsider" its whole policy.

Ductile or nodular iron for pipelines?

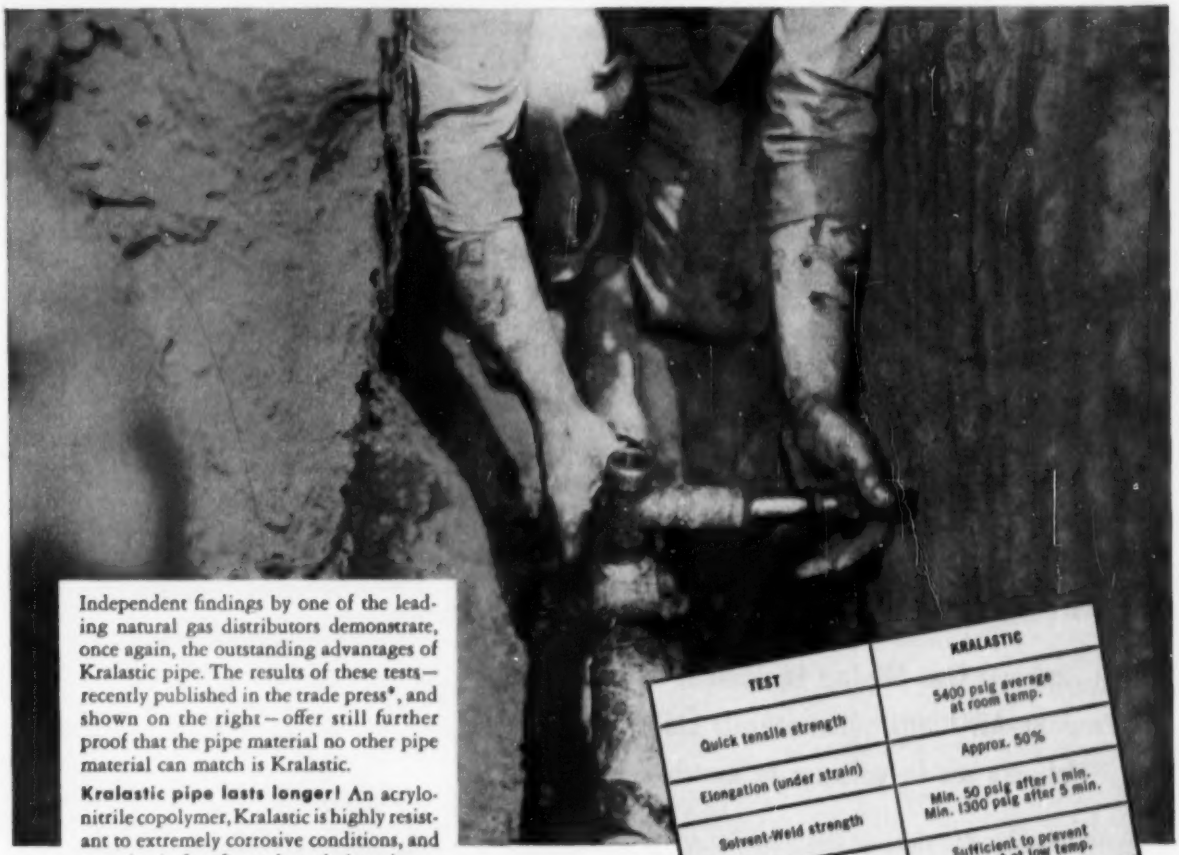
Look for ductile or nodular iron to be used as a material for distribution, and possibly transmission, system pipe. Pipe made from the material has corrosion resistance equal to cast iron pipe, and yield and tensile strengths in excess of API 5LX-42, plus good elongation. In installations made in France, the pipe has been joined aboveground and lowered into the trench like steel pipe. The gas industry is watching a few trial installations that have already been made in this country.

From a field editor's notes . . .

More and more midwestern and eastern companies eyeing Pacific Northwest Pipeline in the hope of sharing in big Canadian reserves. . . . Some companies opposing TGT's midwestern pipeline are scurrying to line up more gas supply to show they can supply the same market. . . . TGT has safe lead in the race. . . . Feeling afoot that FPC should allow a company to depend upon gas supply from small independents—those with not fully developed gas reservoirs —for small percentage of total requirements.

Gas Company's tests prove

Superiority *of* Kralastic *pipe!*



Independent findings by one of the leading natural gas distributors demonstrate, once again, the outstanding advantages of Kralastic pipe. The results of these tests—recently published in the trade press*, and shown on the right—offer still further proof that the pipe material no other pipe material can match is Kralastic.

Kralastic pipe lasts longer! An acrylonitrile copolymer, Kralastic is highly resistant to extremely corrosive conditions, and completely free from electrolytic action.

Kralastic pipe is easy to handle—easy to install! Kralastic pipe lends itself to snaking through existing lines, eliminating costly, time-consuming labor. Solvent welds can be made and tested in minutes, and because Kralastic is lightweight, one man can carry all that's necessary for the average home service.

Kralastic pipe is easy to maintain—exhibits no scale or interior build-up—is unharmed by alcohol or methanol frequently used to clear freeze-ups.

The first rubber-resin to produce successful plastic pipe, Kralastic has proved its unmatched advantages for carrying natural gas, brine, oil, water, and for many other applications. For additional information on how Kralastic® pipe can economically serve *you*, and for your copy of the test report, write to us, today.

*Gas Age, Oct. 7, 1954—Plastic Pipe Is Gaining Approval.

TEST	KRALASTIC
Quick tensile strength	5400 psig average at room temp.
Elongation (under strain)	Approx. 50%
Solvent-Weld strength	Min. 50 psig after 1 min. Min. 1300 psig after 5 min.
Elasticity	Sufficient to prevent pull-out at low temp.
Effect of alcohols and methanol	Very slight
Accelerated corrosion (buried in moist spent oxide)	No trace
Exposure to weather (after approx. one year)	Tensile = 20% above new Elongation = 20% below new

SEE—Naugatuck Chemical Division, United States Rubber Company, at work on NBC's "Color Spread" TV spectacular, Sunday, March 25, 7:30 PM, EST.

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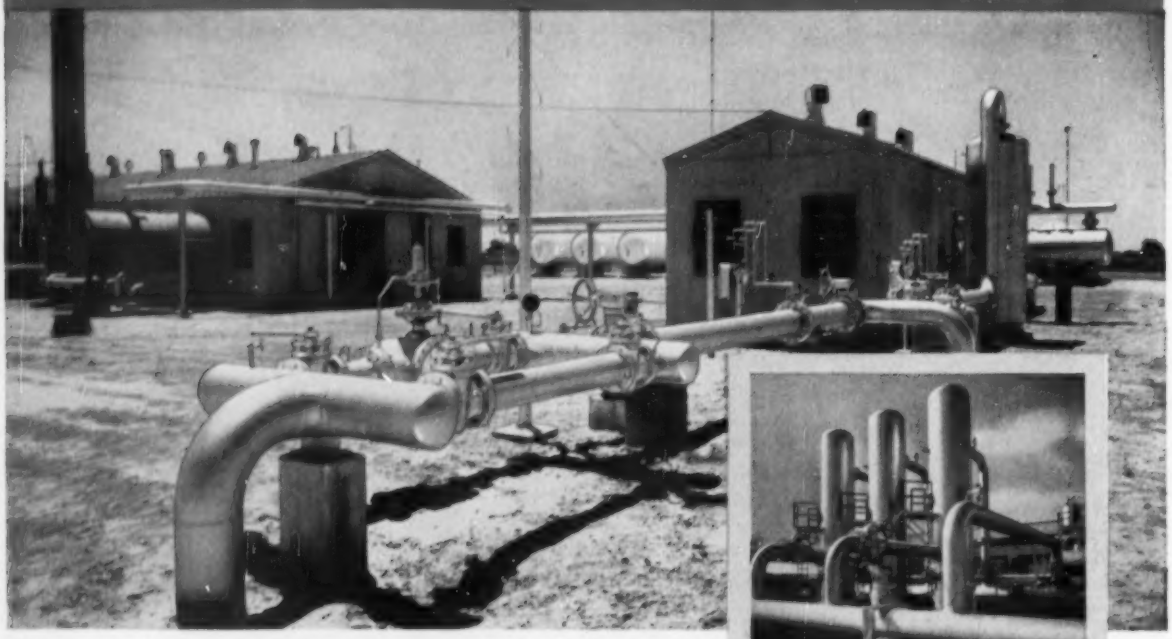
How Southern Union Gas Company meets the problem of Excess Demand



Mixing and pumping facilities, Southern Union Gas Company propane-air plant at Albuquerque, New Mexico. Erected by J. F. Pritchard & Co., Engineers, Kansas City, Mo.

Cutler-Hammer Calorimixer and Calorimeter, part of gas-mixing and stabilizing equipment in Albuquerque plant.

Cutler-Hammer Gas-Mixing Equipment in Albuquerque Propane-Air Plant automatically stabilizes and delivers gas in volumes to match demand

It is not possible to calculate the gas demands of a municipality accurately. Anyone of a number of unpredictables can upset calculations and create excessive demands upon the established natural gas supply. Southern Union Gas Company is one of a number of utilities solving this problem by the erection of propane-air, peak-shaving plants where gas heating value, pressure and volume are handled completely and automatically by Cutler-Hammer Gas-Mixing Equipment designed and engineered by Cutler-Hammer engineers to the customer's specific requirements. Such plants are highly efficient and economical.

Cutler-Hammer Equipment makes operation automatic; heating value and pressure are *always* and automatically stabilized to a preset figure; delivery of gas *always* and automatically matches demand. Such C-H equipped plants are *always* ready to supplement the basic gas supply and take over completely in the event of an emergency failure of basic supply. If you want further information about this most efficient and economical of all peak-shaving plants, write or wire at once. CUTLER-HAMMER, Inc., 1468 St. Paul Avenue, Milwaukee 1, Wisconsin.

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B.t.u. CONTROL
C-H

FPC pricing of pipeline-produced gas challenged by court

MOST of the natural gas industry will be startled by the recent decision of the United States Court of Appeals for the District of Columbia which challenged the method used by the Federal Power Commission in pricing gas produced by an interstate pipeline company in a rate case.

The FPC, in fixing the rates to be charged by the Panhandle Eastern Pipe Line Co., adopted a fair field price method for an allowance in operating expenses covering gas produced by Panhandle rather than a depreciated original cost basis. The result was that customers of Panhandle were required to pay $3,571,000 more each year than would have been the amount required under the utility rate base method. The City of Detroit appealed the FPC decision. The court said that the question presented was whether the larger amount required to be paid by customers, than would be charged were the depreciated original cost method followed, removes the prescribed rates from the lawful "just and reasonable" category.

The interstate natural gas pipeline companies cheered the FPC decision to allow them the fair field price for gas which they produced because it compensated them for the risks taken and encouraged the ownership of gas producing property.

Reasons for FPC fair field price

In deciding the Panhandle rate case, the FPC said that the problem to be solved is what method of pricing pipeline-produced gas will best serve the public interest under present day realities. The commission chose the fair field price instead of the traditional depreciated original cost rate base method. It found that the rate base method (1) tends unduly to accelerate consumption of gas; (2) does not sufficiently encourage its discovery and development, thus failing to promote the national interest in both the production and use of natural gas; and that (3) producing gas by pipeline systems, rather than being dependent for gas upon purchases from other producers, is definitely in the public interest.

The court dismissed the FPC's first reason by saying that the Natural Gas Act does not intrude on the domain traditionally reserved for control by state commissions and that the FPC has no authority over the production or gathering of natural gas. Then the court said that the problem of accelerated usage of gas is like those considerations of conservation with which the commission has not been empowered to deal in rate making.

The court considered the remaining two grounds adopted by FPC to be within the scope of the Natural Gas Act. The court recognized the need for encouraging exploration and development of gas resources. In addition the court reviewed the commission's statement that ownership by pipeline companies of their own gas production would serve the public interest by ultimately resulting in lower rates. The FPC reasoned that this would result because interstate pipeline companies which produce gas purchases, and would also be able to use their own gas in such a manner that the gas from other producers could be obtained at a uniform rate requiring a lower price.

Court dissatisfied with FPC findings

The reviewing court decided that the allowance of the fair field value of Panhandle's own produced gas as an operating expense was not supported by the

*A monthly commentary on national and state developments by an expert in the field of utility law.

Regulatory trends... Pipeline companies must justify the use of the fair field price

evidence and FPC findings to be in the public interest. The court set aside the FPC order and remanded the case to the commission for further proceedings consistent with the court's opinion. The court did not decide that FPC lacks the power to price gas produced by an interstate pipeline company on a basis other than cost, such as the value basis of fair field price. It decided, however, that FPC had not justified the fair field price method to the court's satisfaction. The defects in the FPC rate case decision were described by the court as follows:

"While as we have indicated the commission may be empowered to consider some of these factors it must also, and always, relate its action to the primary aim of the Act to guard the consumer against excessive rates. If the commission contemplates increasing rates for the purpose of encouraging exploration and development, or the ownership by pipeline companies of their own producing facilities, it must see to it that the increase is in fact needed, and is no more than is needed, for the purpose. Further than this we think the commission cannot go without additional authority from Congress.

"The amount allowed Panhandle for the encouragement referred to is not shown to meet this test by any evidence and findings. Of course the rate increase attributable to producing properties might have a tendency to encourage their ownership, and perhaps also the development of new sources of production, as an even greater increase also might do. But the question is whether a lesser amount would suffice. The amount here allowed is not brought into relationship by the evidence and findings with the purposes for which it is granted except that it affords a larger revenue to Panhandle than otherwise it would have. This is not an adequate basis for bringing the resulting rates within the 'just and reasonable' standards of the Act. The mere fact that the field price method is used does not vindicate the rates. Its use can be justified only in terms of a demonstrated public interest. In this case an allowance for the desired purposes, assuming they are valid, could be included without resort to the field price system. When the latter method is used the evidence and findings must show that the increase in rates thus caused is no more than is reasonably necessary for the purposes advanced for any increase. Since there is nothing in these proceedings from which such a conclusion could be drawn, they are fatally defective. In other words, we do not substitute 'our opinions for the expert judgment of the administrators to whom Congress entrusted the decision.' *Federal Power Commission* vs *Hope Natural Gas Co.*, 320 U. S. at 615. We simply say that if the commission is now to abandon the treatment historically accorded pipeline-produced gas in rate making on the ground that the ultimate public interest will be better served thereby, the commission should justify it on the record.

"An additional explanation of our view is desirable. We should not be understood to say that whenever the commission does esablish the necessary relationship between means and end, a prescribed rate increase will be lawful. In view of the primary orientation of the Act toward the maintenance of low prices for the consumer, we do not preclude the possibility that a rate increase might be unlawful even though no lower rate could encourage gas production by pipeline companies. On this record, however, if the necessary relationship had been shown we would not consider the rates so high as to be unlawful.

"Furthermore, it is seen that when we refer to an 'increase' we mean an increase in the rates above those which would result from use of the conventional rate-base method. For, though we hold that method not to be the only one available under the statute, it is essential in such a case as this that it be used as a basis of comparison. It has been repeatedly used by the commission, and repeatedly approved by the courts, as a means of arriving at lawful — 'just and reasonable' — rates under the Act. Unless it is continued to be used at least as a point of departure, the whole experience under the Act is discarded and no anchor, as it were, is available by which to hold the terms 'just and reasonable' to some recognizable meaning."

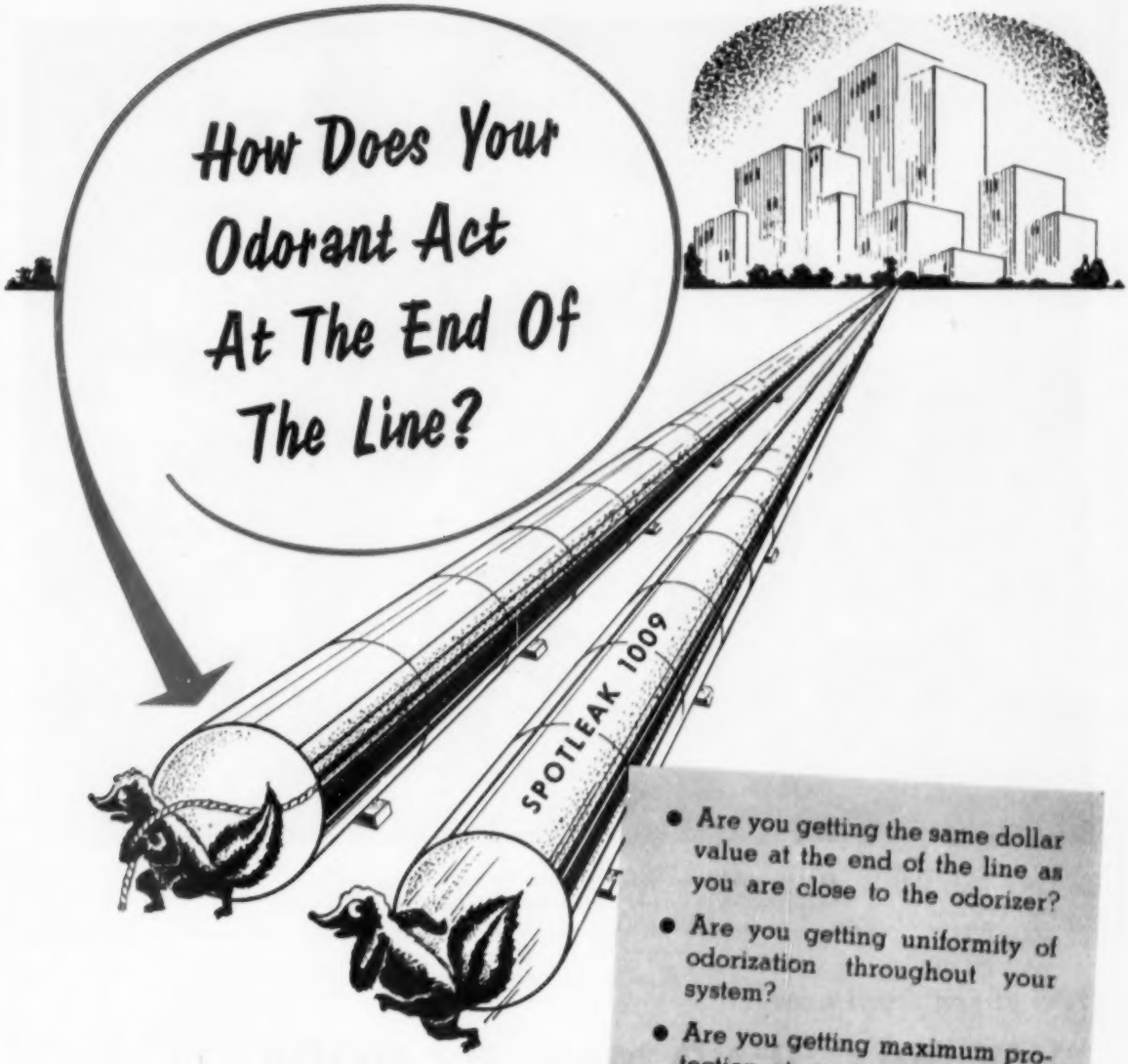
Resourcefulness required

This court decision in the Panhandle case will stimulate resourcefulness of pipeline company managements. In presenting rate cases to FPC, pipeline companies must introduce evidence and reasons which will justify the use of the fair field price to a court's satisfaction.

The court in the Panhandle case alerted the gas industry and FPC to a related problem. The court asserted that in the future proceedings of the FPC, the commission should also consider the impact of *Phillips Petroleum Co.* vs *Wisconsin*, 347 U. S. 672, upon its stated reasons for desiring to encourage pipeline companies to produce their own gas. In *Phillips*, decided subsequently to the commission's order in the instant case, the Supreme Court held that the Federal Power Commission has jurisdiction 'over the rates of all wholesales of natural gas in interstate commerce whether by a pipeline company or not and whether occurring before, during, or after transmission by an interstate pipeline company.' 347 U. S. at 682. The effect of the decision will probably be to subject to federal regulation the prices paid by pipeline companies for most of the gas they purchase. Consequently, the question of indirectly influencing these prices by the means here chosen by the commission, such as augmenting the bargaining power of the pipeline company, may be considerably affected."

Since the continuation of an adequate natural gas supply for the 25 million rate payers in the United States is relatively more important than a modest change in the price, it is likely that the fair field price method of encouraging discovery of natural gas will be sufficient justification. ■

How Does Your Odorant Act At The End Of The Line?



- Are you getting the same dollar value at the end of the line as you are close to the odorizer?
- Are you getting uniformity of odorization throughout your system?
- Are you getting maximum protection at a minimum cost per pound at the ends of your lines?

SPOTLEAK 1009 offers you all of these advantages. It merits your consideration on the basis of quality and cost-performance.

Our technical representatives who call on you are prepared to explain the basis of our claims.

SHARPLES CHEMICALS Division

PENNSYLVANIA SALT MANUFACTURING COMPANY

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Shawinigan Chemicals, Ltd., Montreal • Toronto

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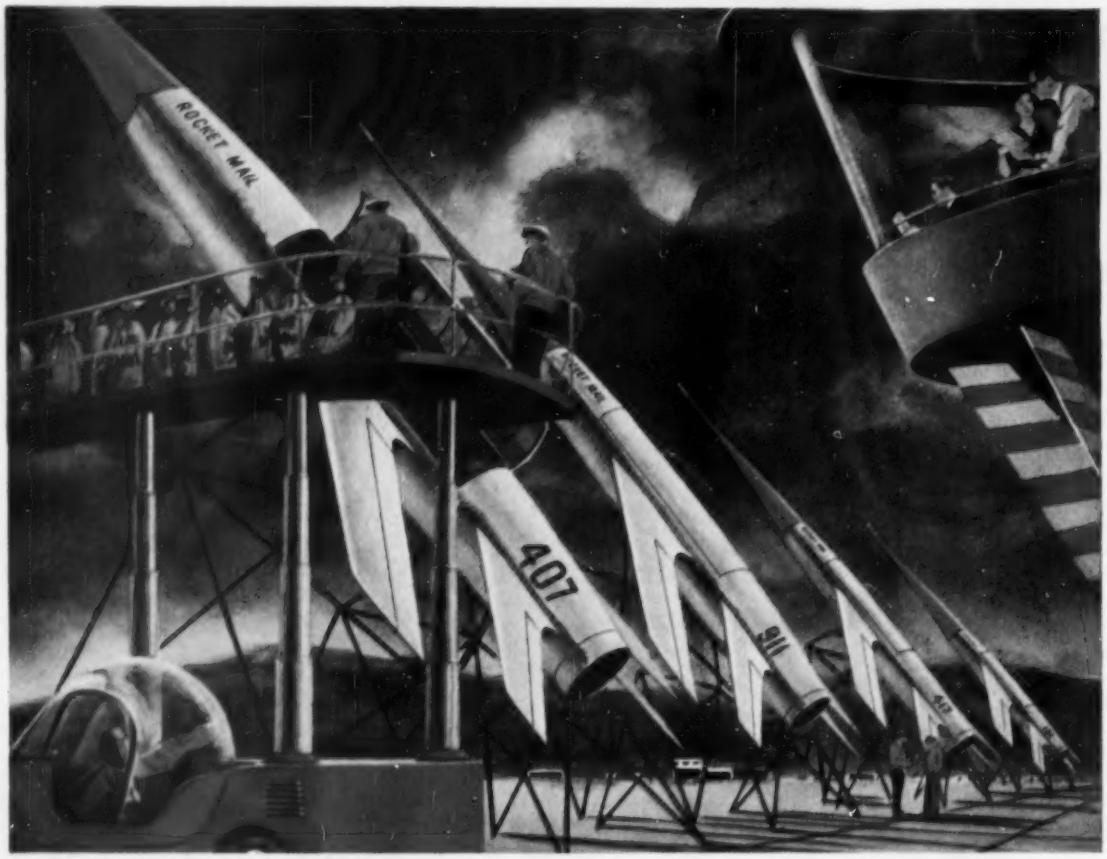


RADAR controlled and guided, high speed rockets streaking through the stratosphere may deliver New York mail to San Francisco in less than an hour!

100 years from now...

WE MAY SEND MAIL BY ROCKET!

A century from now a wonderful, exciting and different world. But there will be one familiar note. The cast iron pipe laid today will still be carrying water and gas to the homes and industries of tomorrow.

In over 60 American cities, these dependable cast iron water and gas mains, laid more than a century ago, are still serving efficiently. And modernized cast iron pipe, centrifugally cast, is even stronger, tougher, more durable.

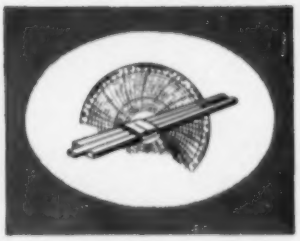
U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

technical trends



• By GUY CORFIELD

Certified heating value natural gas available from AGA

On this page in the November 1955 issue, under the heading "Heating Value of Natural Gas," mention was made of the near completion of an AGA-sponsored program whereby cylinders of natural gas, certified for heating value by the National Bureau of Standards, would soon be available. It was stated that "anyone desiring to obtain this standard gas is urged to write to the Bureau of Standards and ask it to inaugurate the service as soon as possible."

We are now advised by AGA (T.L. Robey, coordinator of research) that this gas will be available through AGA rather than through the Bureau of Standards, and that inquiries or tentative orders should be addressed to AGA headquarters, 420 Lexington Ave., New York 17. It is expected that a small number of cylinders will be available beginning March 1, for approximately $50 per cylinder plus transportation. The initial group of cylinders will be certified for Btu only as the bureau is not presently equipped to measure specific gravity to the required accuracy. However, it is hoped that at a later date the certification will be for both heating value and specific gravity so that the gas can be used for the calibration of both calorimeters and gravitometers.

Solar energy

The five-day Conference and World Symposium on Applied Solar Energy, held in Phoenix and Tucson, Ariz., last November under the joint sponsorship of the Association of Applied Solar Energy, the University of Arizona and Stanford Research Institute, is reported by the latter organization as having been very successful. Some 1100 industrialists, business men and government representatives, from the United States and 34 foreign countries, attended the meetings, heard 120 reports and papers and viewed 77 exhibits, dealing with high-temperature furnaces. Solar stills, conversion to mechanical and electrical energy, algae and higher plant cultures, application of solar space heating and cooling, and other conversion processes.

Such developments were described as a 1000-kw 200-ft diameter solar furnace for high temperature industrial applications, being built by the French National Research and Scientific Organization; a Stanford Research Institute project for converting solar energy into chemical energy, supported by the Office of Scientific Research of the U. S. Air Force; and substantial progress in the design of "collectors" for residential space heating and cooling and water heating, particularly applicable to the rapidly developing and generally sunny southwestern portion of the United States.

Plans are assertedly well advanced for the establishment of a Solar Research Center in Arizona, to be operated by Stanford Research Institute under the sponsorship of the Association for Applied Solar Energy, to provide a laboratory for basic and applied research projects and to establish a source of world-wide information on solar energy developments.

The gas industry will be interested to know that John I. Yellott, who at one time was director of the industry's Institute of Gas Technology at Chicago, has joined Stanford Research Institute as assistant director and is now in Phoenix in connection with the development of this research center.

The deepest hole

The record for the world's deepest drilled hole, formerly held by the Ohio Oil Co.'s well in Kern county, Calif., has now been topped . . . or, rather, bottomed . . . by a distance of 1077 ft by the Richardson & Bass Co., whose drill has penetrated to 22,550 ft (4.3 miles) in the marshland 35 miles southwest of New Orleans.

It is planned to stop drilling at this depth, and attempt production at 21,520 ft, and if this is successful it will be the world's deepest production also. Naturally there have been and will be many mechanical problems, intensified by 2000-lb pressure and a temperature of 350°F at the bottom of the hole. The operation will have taken approximately one year and cost $2 million.

Weights and measures

Engineers frequently have to convert from one unit of weight or measure to another, both in the "English" system customarily used in the U. S., and in the metric system (used also, of course, in the U. S.). Sometimes considerable accuracy is needed and arguments can develop over minor discrepancies or conflicting data in handbooks. A useful publication, therefore, is one entitled "Units of Weight and Measure . . . Definitions and Tables of Equivalents" recently issued as Miscellaneous Publication 214 by the National Bureau of Standards and available from the Government Printing Office, Washington 25, D. C., at a cost of 40 cents.

This publication defines the units of length, mass, area, volume, and capacity in use in the U. S., and also gives tables of interrelation and tables of equivalents between the English and metric systems. It also contains sections on the fundamental equivalents, and the approved spelling and abbreviation of each of the units. All of the data have been revised to conform to current definitions, equivalents and usages. It supersedes a similarly titled Misc. Publication 121 issued in 1936.

TYPE 99-1
2" screwed connections, hi-tensile iron, steel or bronze body.

FISHER®

The Fisher Series 99 is adaptable to hundreds of applications now requiring an assortment of several types of regulators. It is the ideal regulator to have in stock.

From Inches Water Column to 20 psi Outlet Setting —with only a simple adjustment or spring change.

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FEATURES

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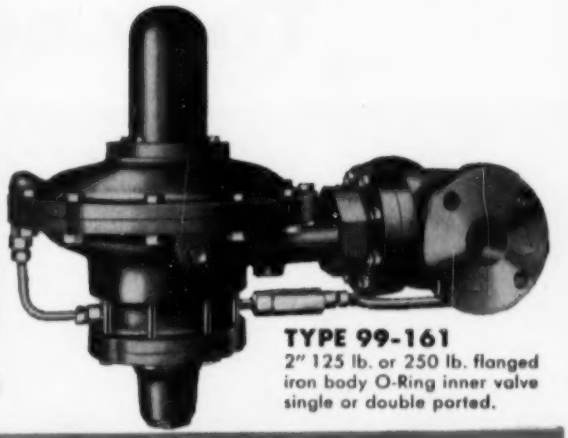
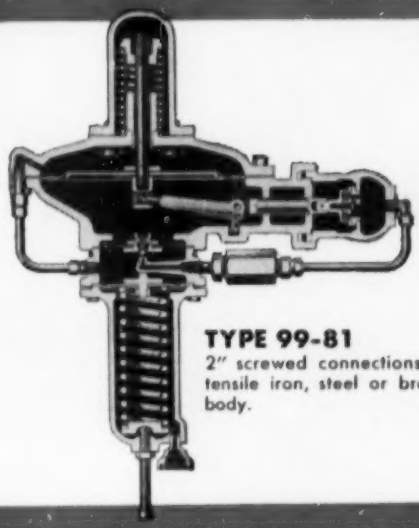
MULTI-PURPOSE PRESSURE REDUCING

Gas Regulators

SCREWED or FLANGED CONNECTIONS



TYPE 99-161
2" 125 lb. or 250 lb. flanged iron body O-Ring inner valve single or double ported.



TYPE 99-81
2" screwed connections, hi-tensile iron, steel or bronze body.

TYPE 99-101
2" 125 lb. or 250 lb. flanged iron or 150 lb. or 300 lb. flanged steel body.

COMPANY · MARSHALLTOWN, IOWA
CANADIAN PLANT: WOODSTOCK, ONTARIO

FISHER Since 1880

BETTER GAS PRESSURE CONTROL

They bought on faith

Photo: Ewing Galloway

This is Providence, seaport and largest city, also the capital of Rhode Island.

This is Providence as it looked in the early 19th Century, over 100 years ago.

Print: Bettmann Archive

CAST IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

MODERNIZED cast iron

100 years ago– they buy on proof today

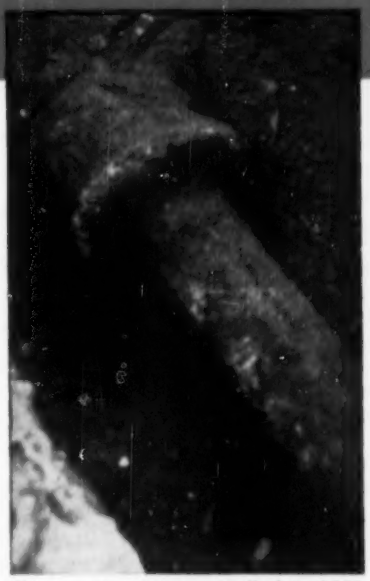
Providence Gas Company bought cast iron pipe 100 years ago– and still buys it.

Providence Gas Company was granted its original charter in 1847. Population of Providence was then about 36,000. Today this Company is serving approximately 100,000 customers in Providence and adjacent cities and towns. The distribution system contains about 950 miles of mains, more than 80% of which is cast iron pipe.

Providence Gas Company, and public utilities in over 60 other cities, bought and installed cast iron pipe for underground mains that have been in continuous service for more than a century. They bought on faith founded in good judgment. Today, they continue to buy cast iron pipe because they have *proof*—proof of the long life, dependability and economy of this time-defying pipe.

Today's *modernized* cast iron pipe—centrifugally cast and with standardized mechanical joints, is even more economical and efficient. The pipe is stronger, tougher, more uniform in quality. The mechanical joints are bottle-tight for usual gas pressures and for all types of gas.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.



This cast iron pipe, installed in 1852, is still in service in the gas distribution system of Providence Gas Company, Providence, Rhode Island.

A FEW OF THE 35 GAS UTILITIES WITH CENTURY-OLD CAST IRON MAINS IN SERVICE

Peoples Gas Light and Coke Co., Chicago—Consolidated Gas Electric Light and Coke Co., Baltimore—Philadelphia Gas Works—Richmond Gas Works, Richmond, Va.—Hartford Gas Company, Hartford, Conn.

pipe FOR MODERN GAS DISTRIBUTION

ECONOMY IN PLANNING CALLS FOR Gas
Home planners with modern ideas are finding that Gas is . . .
DEPENDABLE
MODERN
AUTOMATIC
FAST, CLEAN
SAFE and SILENT
. . . gives any degree of heat control
. . . is always on the job regardless of the weather
YES, Gas gives you MORE
MORE FREE TIME because now GAS is more automatic and dependable than ever before! New dream gas ranges watch the clock and turn gas on and off while you're away. New incinerators burn all refuse — end the garbage nuisance!
MORE SPACE FOR LIVING with gas heating units which can be tucked into a tiny closet. More comfort from the new gas air conditioners.
MORE ECONOMY, TOO! You enjoy low initial cost, lower operating costs, more comfort and convenience . . . with GAS equipment and appliances.
MORE SELECTION! Because only silent, safe, GAS offers all 7 — Ranges, Refrigerators, Furnaces, Clothes Dryers, Air Conditioners, Water Heaters and Incinerators.
Only GAS gives you all 7 home services
Now you can have more with GAS is brought to your attention by these Suppliers to the Gas Industry:
Rockwell Manufacturing Co. • U. S. Pipe & Foundry Company
M. B. Skinner Company
SEE YOUR DEALER OR GAS COMPANY TODAY AND LEARN HOW MODERN YOUR HOME CAN BE WITH GAS
The Saturday Evening POST
I WAS A PRISONER OF SILENCE
By a Minister Who Lost His Voice
HOLLYWOOD'S HARDEST MAN
By Donn Jennings

Rockwell Promotes The Industry It Serves

NOTE TO UTILITIES

Free color reprints of these ads and mats for black and white reproduction, with space for your company signature, are available upon request to GAMA headquarters.

Let's all get behind the Gas Business ....*and push!*

. . . . . This is good but let's go further!

A fine start has been made toward helping the utilities sell more gas. A regular schedule of advertising is now appearing in the Saturday Evening Post. To this, credit forward thinking by The Equipment Manufacturer's Advisory Committee of GAMA. *But only nine (9) suppliers* to the Gas Industry are sponsoring this program. *There should be 90!*

Let's face it. These nine suppliers are carrying too heavy a burden—or to put it another way, too few are trying to do too big a job.

The Gas Industry's future growth potential is tremendous. There's a 38,000,000 increase in population forecast for the next 15 years. And, of course, there's a huge replacement market to be tapped for modern gas appliances.

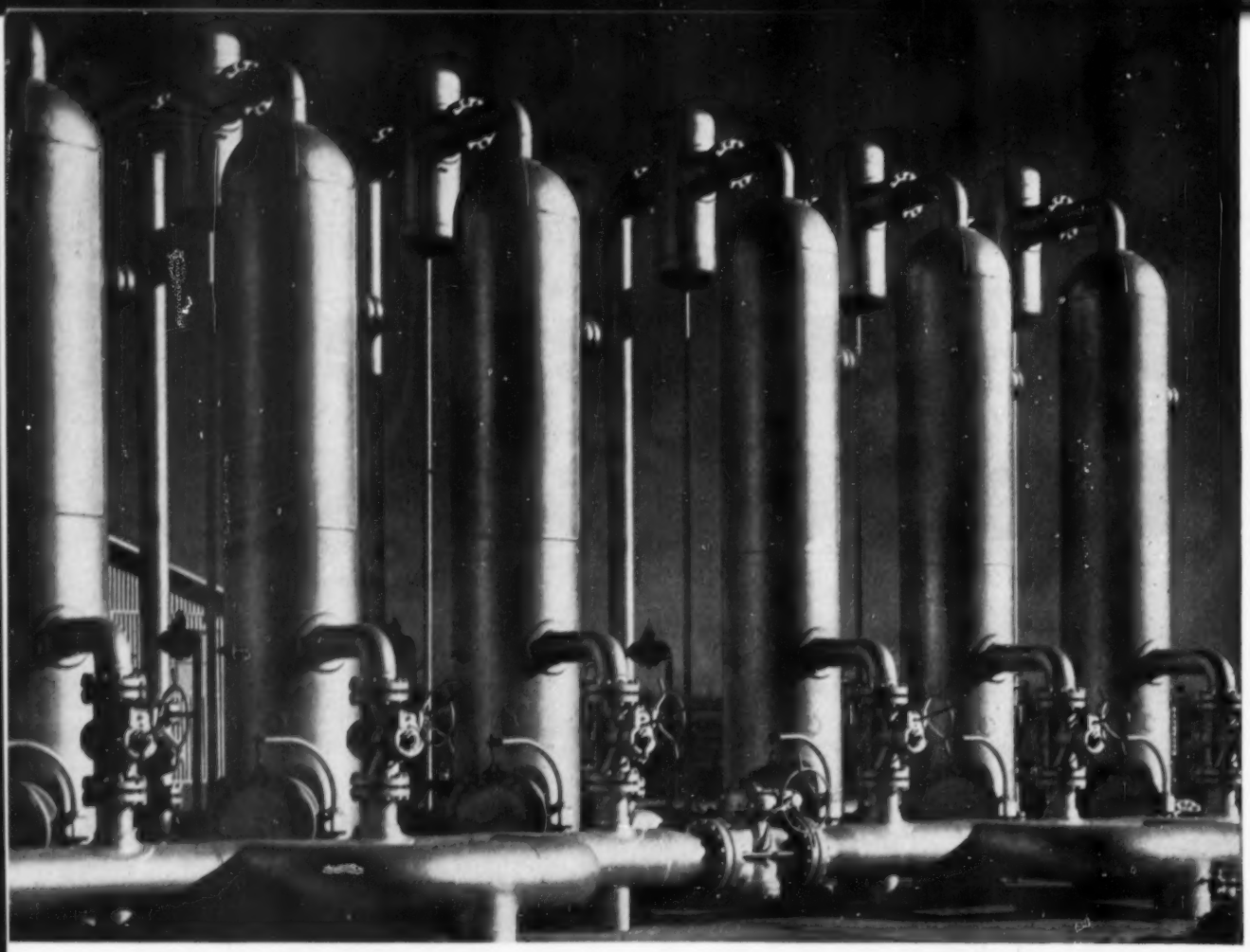
Let's stop losing appliance sales (and loads) to the competition. Let's all grow —gas utilities and suppliers alike, by telling the gas story over and over again to present and future home owners.

All suppliers are invited to participate in this important promotion program. For details write The Equipment Manufacturer's Advisory Committee, GAMA, 60 East 42nd St., New York 17, N.Y.

Published as a service to the Gas Industry by

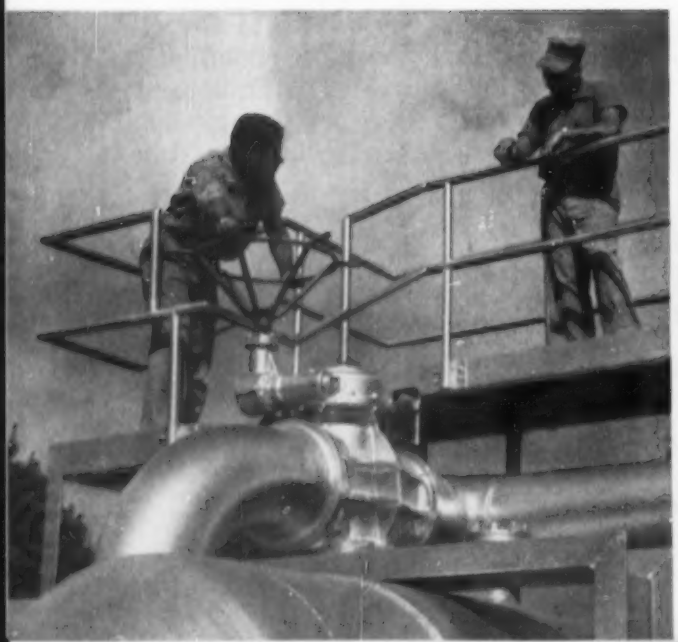
Rockwell Manufacturing Company

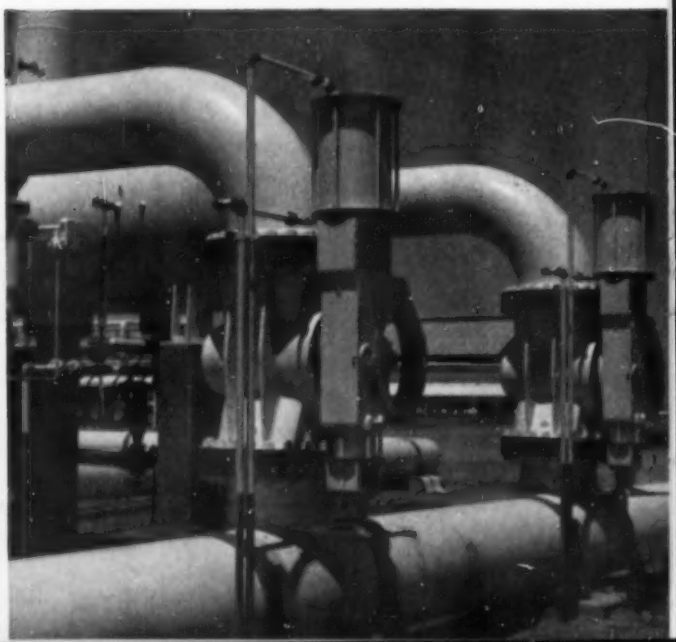
PITTSBURGH 8, PA.



40th YEAR *of lubricated plug valve leadership*

ROCKWELL





Why you always see ROCKWELL-Nordstrom VALVES Everywhere there's GAS

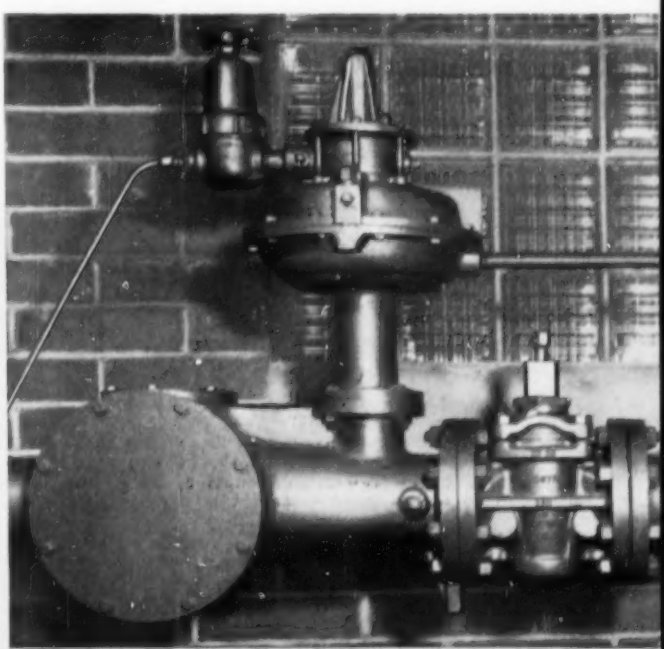
Rockwell-Nordstrom valves are used in more gas services than any other valves. The reason: Pressurized lubricant sealing for leak-proof safety . . . quarter-turn, instant operation . . . unexposed seating . . . and lubricant protection for long, low-cost service life. You can't get these features in ordinary valves at any price, yet Rockwell-Nordstrom valves cost no more to buy, often less.

Rockwell-Nordstrom valves are available in sizes to 34″ and pressures to 10,000 lbs., for gas production, transmission or distribution services. For more information, see your nearest distributor or write: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed for Positive Shut-Off



BEST TOGETHER

best gas odorant — best odorant service

Alert "80"

Your best economy-priced, quality mercaptan. Alert "80" gives better, full-range volatility and stronger initial "punch"—proved in all types of distribution systems by both large and small utilities. Alert "80" is a selected and blended group of mercaptans proved over the years to be *best* for natural gas odorization.

Calodorant "C"

Your best quality sulfide type

The only gas odorant in use that completely volatilizes under the most extreme high-pressure or low temperature operating conditions. Calodorant "C" is equally effective at medium and low pressures.

Specialists in odorization problems!

Since marketing the first gas odorant in 1927, Oronite's continuous research program has answered many a critical gas odorization problem. Being a leader in the field, chances are our experience can answer any problem you may have.

Oronite Odorometer

At last—a simple way to test odor intensities in distribution systems. Ask for a demonstration of the Odorometer—just contact any Oronite office.

ORONITE CHEMICAL COMPANY

EXECUTIVE OFFICES: 200 Bush Street, San Francisco 20, California

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ORONITE CHEMICAL COMPANY

Utilities pipeline contractor

Averages 20 feet of trench per minute, digs 2 to 4 jobs per day with each of his Clevelands

1000 feet of complete pipeline construction—trench digging, pipelaying, backfilling and backfill compaction—is an average day's work for each crew of F. H. Linneman, Inc., pipeline and utilities contractor of Denver. Most of this work is on 2-, 4- and 6-inch pipelines for the many new housing developments in the Denver area.

With a Cleveland Trencher opening up trench at an average rate of 20 feet per minute, a typical Linneman crew will do 2, 3 or 4 complete pipeline jobs in an 8-hour day—jobs that run from 50 to 1000 feet each in length. One of these crews has a record day's production of 7 complete jobs.

Currently operating 7 Cleveland Trenchers, Linneman specializes in utilities work—gas, water and sewer line construction. Equipment-minded and especially maintenance-conscious, he has consistently employed Clevelands ever since he began his contracting business in 1946.

Fast portability of equipment is essential in Linneman's tight-scheduled operations. His Clevelands can be loaded on their low-bed trailers in less than 10 minutes time, ready to roll safely from job to job at legal limit speeds.

"Maintenance costs on Clevelands are appreciably lower" says owner of 7

Here is what F. H. Linneman has to say about trenchers:

"In the type of work we most generally perform, in the city especially, we have found Clevelands best suited to our operations because of their narrow-width construction, compactness and speed. They enable us to work in close places and keep trenching ahead of follow-up operations, a decided advantage.

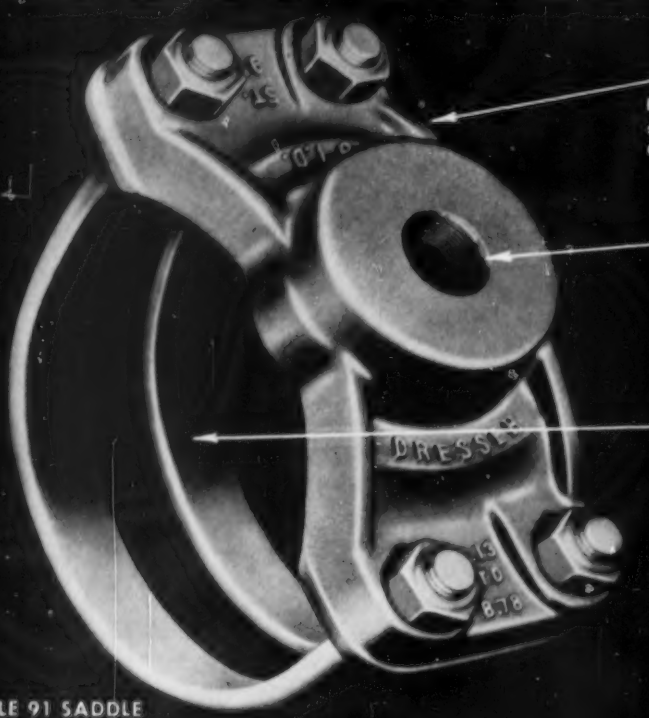
"We have employed Clevelands in our work since we began contracting in 1946. We have seven of them at the present time, the oldest being a Cleveland Model 95 purchased in 1948. We have no record of the miles this machine has dug, but feel that it would be a near-record. Our maintenance costs on it have been extremely low.

"Our over-all maintenance costs on Clevelands are appreciably lower than on other trenchers we have operated. This is another reason why we have purchased more Clevelands than any other make. We have also found it easier to train operators for Clevelands than for any other make. Our newest Cleveland, a "240," was delivered only last week by H. W. Moore Equipment Co., here in Denver."

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave. Cleveland 17, Ohio

CLEVELAND

NOW AVAILABLE



STYLE 91 SADDLE
(8" ID)

HEAVIER CONSTRUCTION
Bodies designed with heavily reinforced sections, ruggedly constructed from Grade A malleable iron.

FULL TAPPING RANGE
Available with IPS Thread taps to 2 inches in size. Large boss insures full threads.

FLAT STEEL STRAPS
Accurately shaped, high tensile steel straps conform to pipe. Wide, flat surfaces prevent cutting or crushing.

FITS RANGE OF PIPE
Fits steel and cast iron pipe within size range clearly marked on each saddle.

NEW DRESSER SERVICE SADDLE

...designed for long, rugged service

The new Dresser Style 91 Service Saddle has been carefully designed for maximum dependability, economy and ease in making gas service connections.

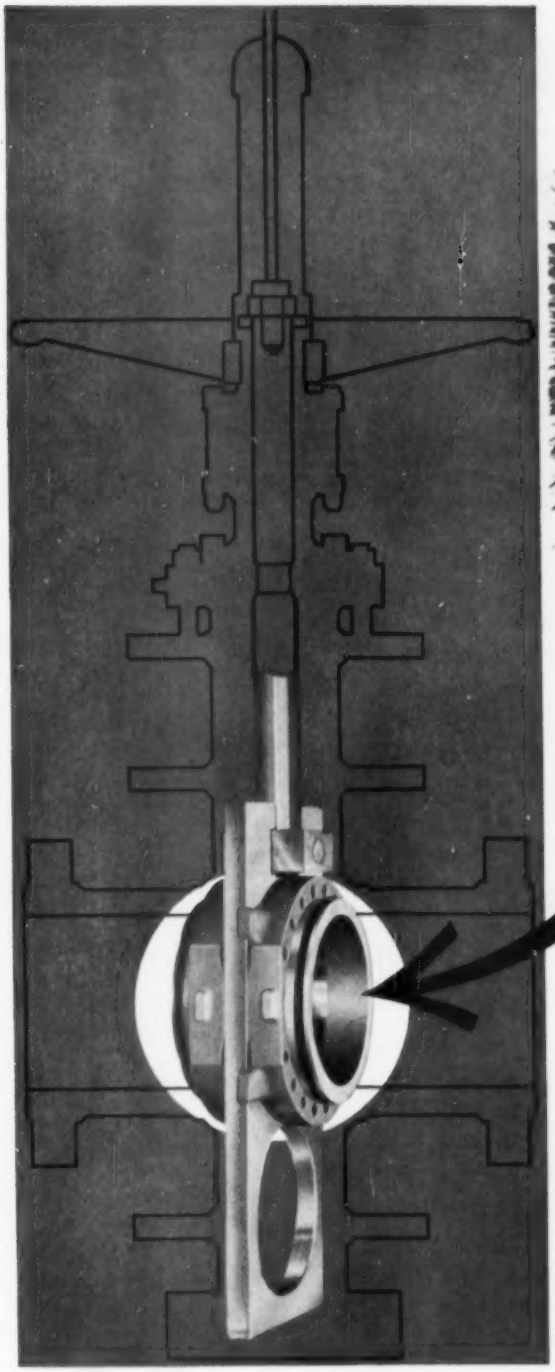
The body of the saddle is heavily constructed with a Dresser gasket of time-proven Grade 27 compound securely cemented in place. Cold-rolled threads give the bolts greater strength and added resistance to corrosion.

Style 91 Saddles are heavily galvanized or protected with Dresser's new plastic dip. This coating covers all threads as well as saddle surfaces, has dielectric strength, will not "plate out". Saddles are packaged for convenient handling and storage.

Order a stock of Dresser's new, economical Style 91 Saddles today. Your Dresser field engineer has full details.

DRESSER® ONE OF THE DRESSER INDUSTRIES

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa.
Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Atlanta, Denver. In Canada: Toronto and Calgary.



the WHOLE VALVE is RIGHT HERE

- **Line pressure is isolated in the conduit while valve is open or closed**
- **Bubble-tight seal on both sides of the gate may be checked after each operation**

Grove Seal-O-Ring Gate Valves with the exclusive new fabricated body design offer an extra wide margin of safety, because line pressure is isolated in the conduit when the gate is either full open or closed. This means that the body is required only as a framework for the simple operating mechanism, and to prevent loss of fluid or gas while gate is being moved. When gate is open or closed, body may be drained or vented to atmosphere – and integrity of both upstream and downstream seals may be checked by means of a simple tell-tale valve on the body. For 2" to 36" size requirements for all wanted working pressures.

601

GROVE SEAL-"O"-RING Gate Valves

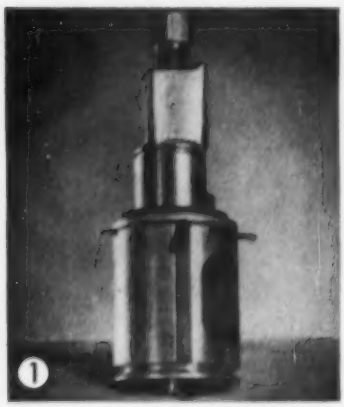
GROVE VALVE and REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California
HOUSTON 4 — 1901 Calumet St. • • • • • • • • LOS ANGELES 6 — 1930 W. Olympic Blvd.

ODESSA, TEXAS • TULSA, OKLAHOMA • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED

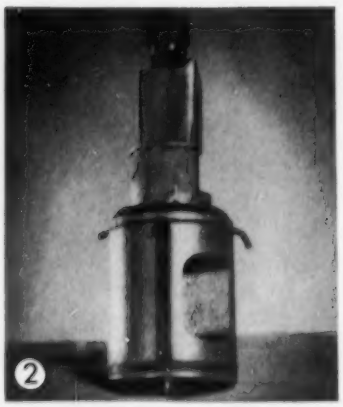
GROVE SEAL RING GROVE SIMPLICITY ACCURACY SAFETY

*SEE HOW *Controlled*
PRESSURIZED LUBRICATION
GUARANTEES LOWEST COST SERVICE FROM

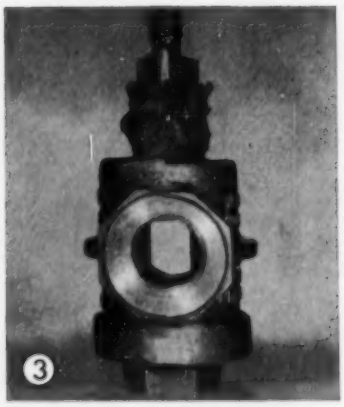
HOMESTEAD *lubricated* PLUG VALVES



This plug was removed from a Homestead Valve just after starting lubrication, and before all sealing areas were filled with lubricant. Note that pressurized lubricant continues to extrude through feeder holes. Momentary downward movement of plug at start of each lubrication, gives assurance that plug is always free to turn.

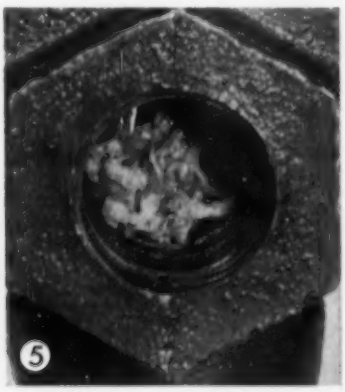


The plug was again withdrawn from the valve body just after a ring of lubricant around the stem indicated that the lubricant system was full. Note that all lubricant grooves are filled. The entire plug surface is coated with lubricant. Lubricant is well packed in the stem sealing area above the plug.



Now valve has been purposely over-lubricated as indicated by excess lubricant around stem. Note that with *controlled* pressurized lubrication there is no extrusion or seepage of lubricant into valve port opening. This means no waste, no contamination of line fluids, no clogging of low pressure lines with lubricant, or fouling of meters, orifices, etc.

Also, in the Homestead Valve with *controlled* lubrication, you will note that even though the valve has been over-lubricated, lubricant comes only to the bottom edge of the plug, and is not wasted by discharging in quantity into the bottom chamber.



Now, see for yourself the risk involved when a valve which does *not* have Homestead's *controlled* Pressurized Lubrication, is over-lubricated. Note lubricant has been forced into the port opening. It can contaminate line fluids, foul meters or orifices, or even block low pressure lines!

* Unretouched photos.

These are but a few of the many advantages of Homestead's controlled pressurized lubrication that guarantee lowest cost valve service.

Reference Book 39-5 has the full story—twenty-eight pages of engineering facts, sizes, types, dimensions, etc. Ask for your copy today. There is no obligation.

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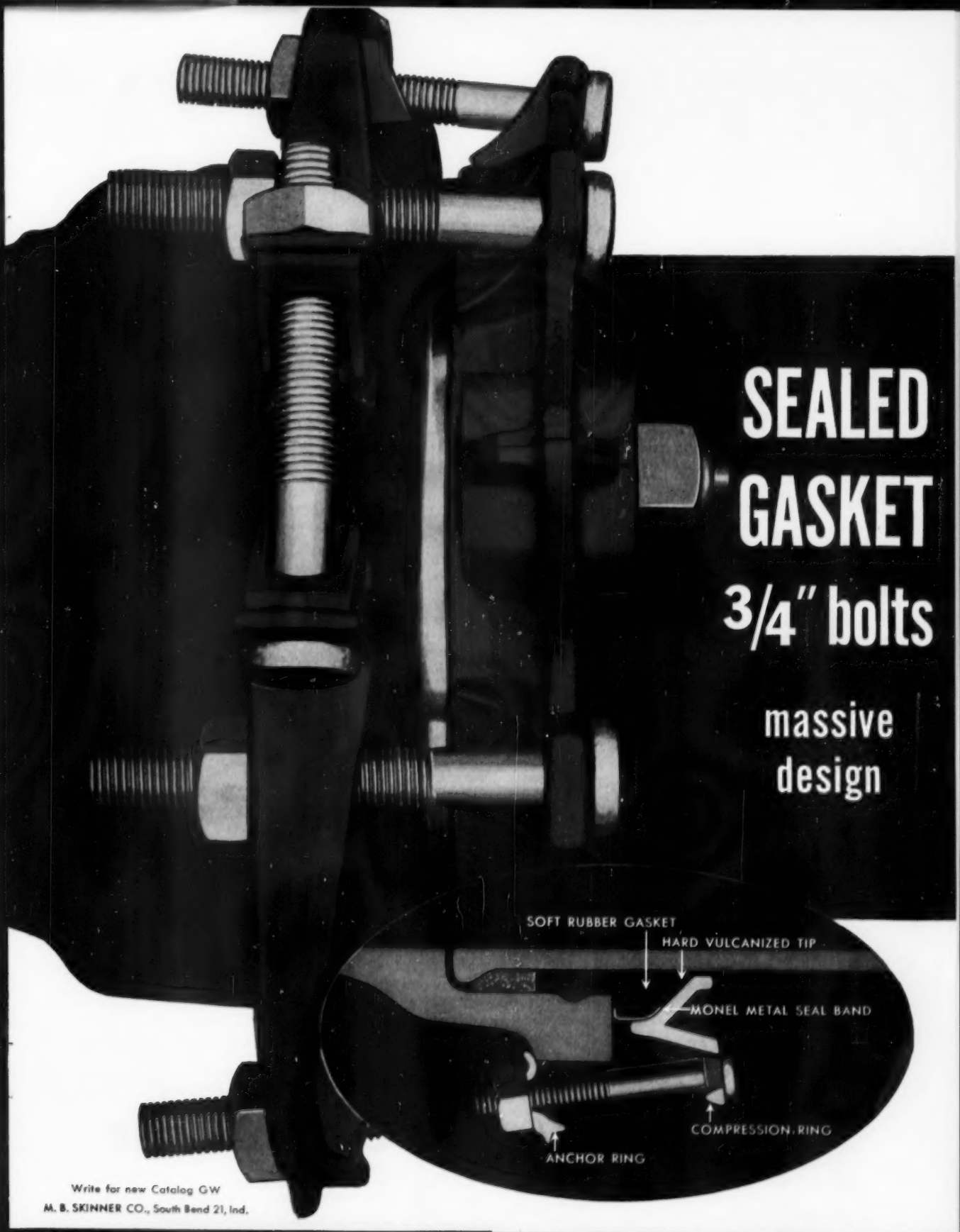

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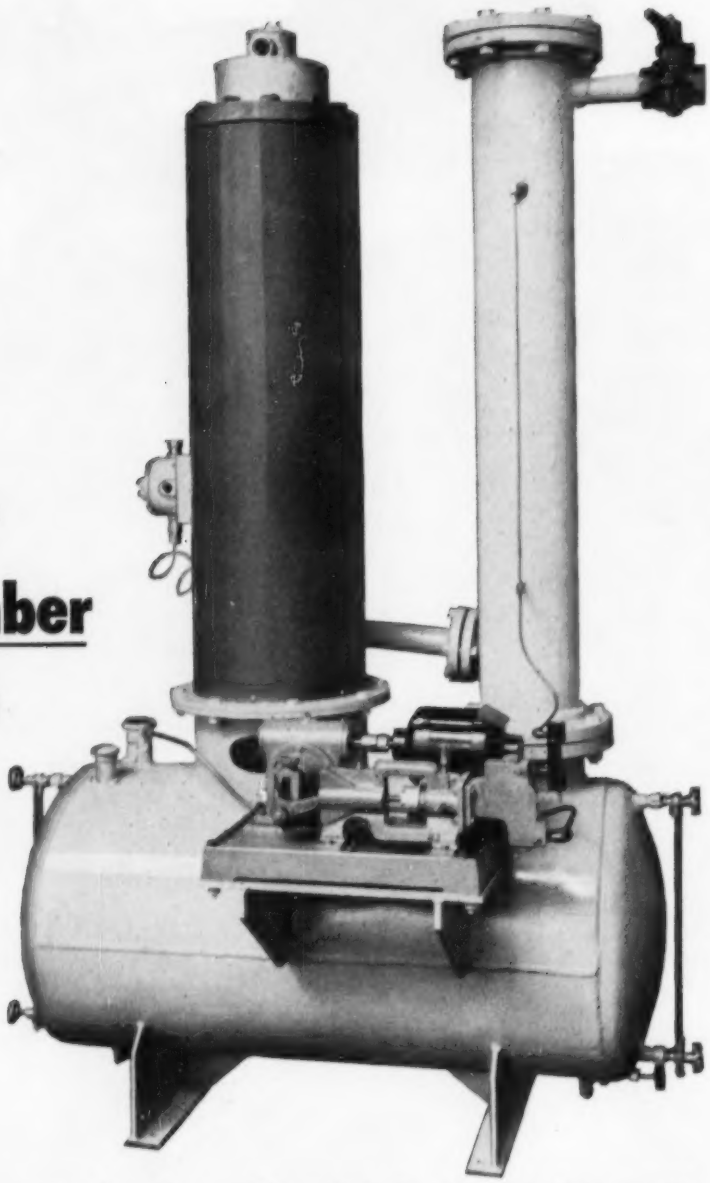

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*Process patented.

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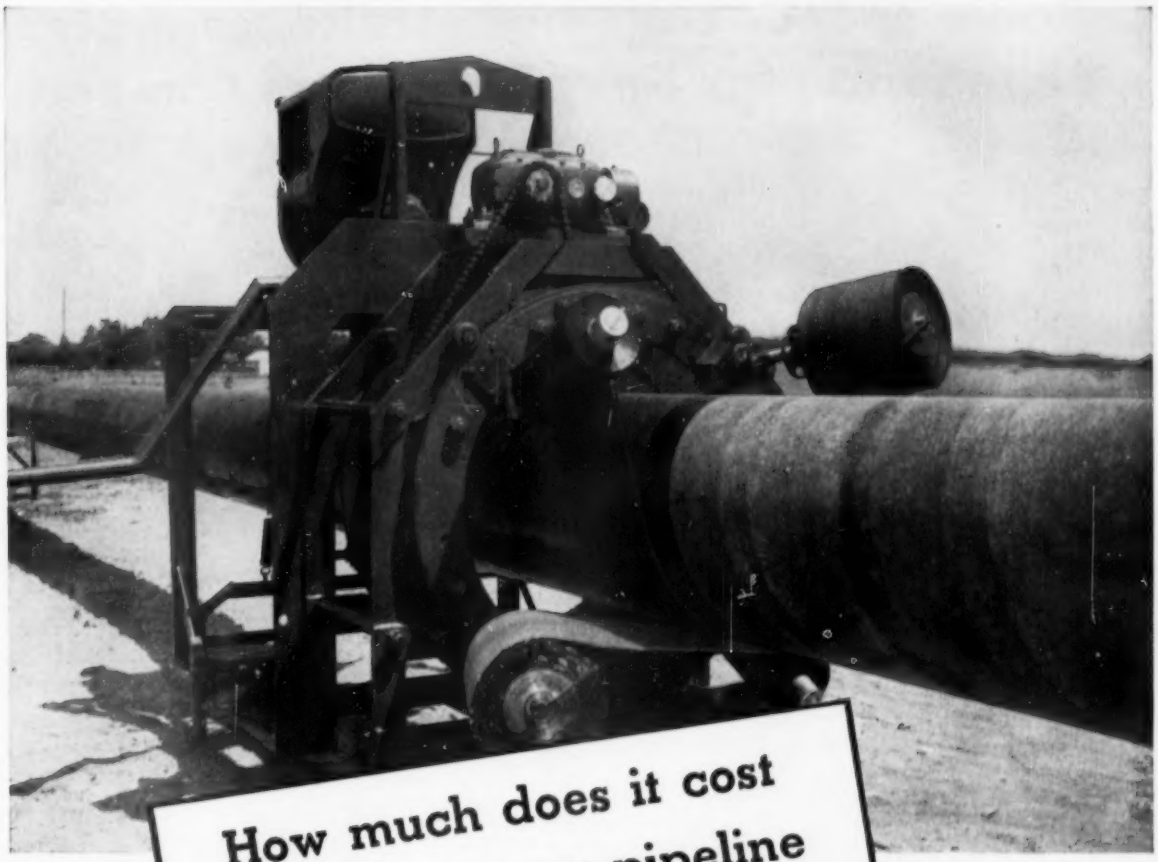

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One hundred twenty two mobile units and two base stations, in service with the United Fuel Gas Company, Charleston, W. Va., are equipped with G-E 2-way radio. United was the nation's first firm to incorporate new Progress Line units into their radio-equipped fleet.

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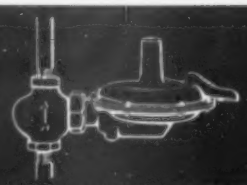

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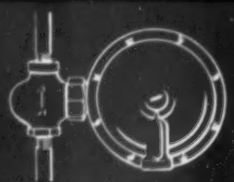

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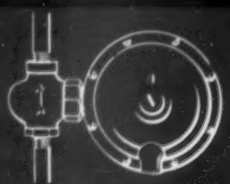
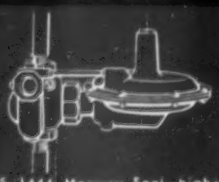


SERIES 1403 Horizontal Vent.



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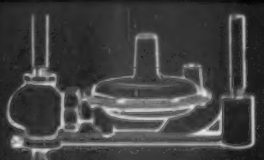

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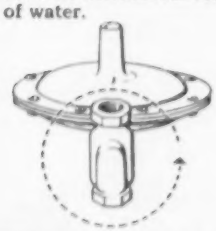
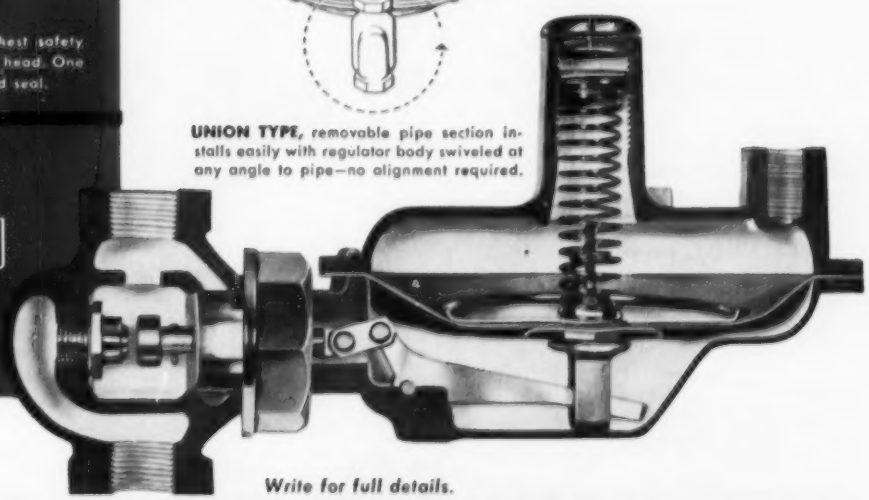


UNION TYPE, removable pipe section installs easily with regulator body swiveled at any angle to pipe—no alignment required.



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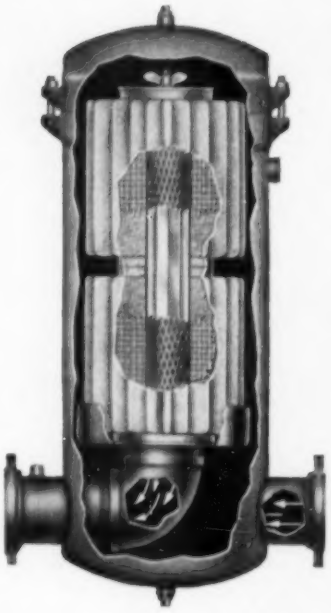

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Typical trench depth on $1,000,000 sewer excavation job by Geo. Sheaf & Company. Le Roi air power and Le Roi-Cleveland air tools were used to drill through rock.

Le Roi-Cleveland PL30 Drill Rigs, hung from crane boom, cut production time in half on the rock drilling project by Geo. Sheaf & Company near Tiffin, Ohio. Le Roi 600-cfm portable air compressors, and a self-propelled, 125-cfm Le Roi Tractair provided air power.

Rock-Drill Rig on Sewer Job Speeds Production 50%

Contractor uses Le Roi-Cleveland Air Tools to shoot and pull rock, often 18 feet deep, with one drilling.

The right air tools made quite a difference on a $1,000,000 sewer excavation near Tiffin, Ohio. Joseph Parker, General Superintendent of Geo. Sheaf & Company, Columbus, Ohio, states, "In nearly seven months of service in hard limestone, our Le Roi compressors and Le Roi-Cleveland Rock Drills had no down time, while in continuous operation 8 to 16 hours per day. They have performed to our utmost satisfaction. By using Le Roi-Cleveland PL30 Drill Rigs, we lowered our drilling costs and speeded production by 50 per cent."

Flexibility of special drill rig was a major factor in job speed-up. The Le Roi-Cleveland PL30 Drill Rigs provided unusual flexibility and ease of operation. This specially-designed rig, developed for rock work on pipeline projects, allowed the contractor to obtain proper drilling patterns for safe blasting in residential areas. Thus he cut construction time in half because he could shoot and pull the rock with only one drilling.

The Contractor standardized on Le Roi-Cleveland Air Tools using two PL30 Drill Rigs, two Model 52 Breakers, and two H10B Sinker Drills, plus hose, drill steel, and rock drill bits.

Le Roi air power helped speed up this project. Two Le Roi 600-cfm portable air compressors, and one self-propelled Le Roi Tractair (a combination 42-hp. wheel tractor and 125-cfm air compressor) were used.

This combination of Le Roi air power and Le Roi-Cleveland air tools gave the contractor exceptional drilling economies, including manpower savings, less upkeep, and more footage per shift.

Le Roi Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufactures portable and stationary air compressors, heavy-duty industrial engines, the Tractair and air tools. Write today for information about any of these products.

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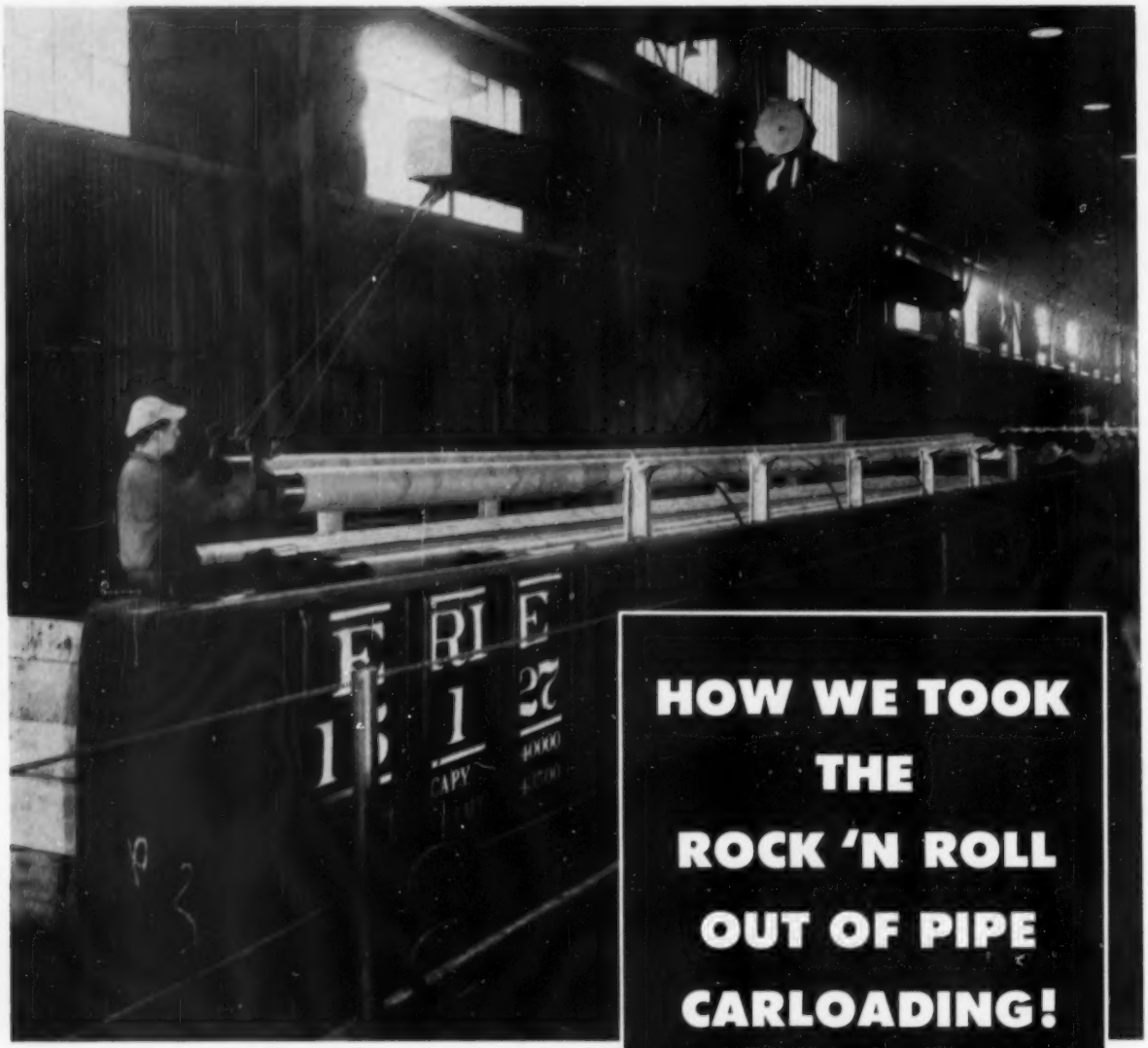

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GAS exclusive

Control of gas mixing process

Part 1 of a 3-part series on the fundamentals of gas mixing

GAS
FEBRUARY 1956

By C. W. WARNER, Development Supervisor • Cutler-Hammer Inc.

AT THIS point in the development of the gas industry, most of us would feel the picture was indeed rosy if all distribution companies could be supplied with enough firm natural gas, at a good price, to supply all existing needs and facilities expected expansion. To make this ideal picture complete, the continuity of this natural gas supply would have to be assured. In actual practice, the gas supply to the distribution companies is not so blessed.

Many distribution companies operate manufactured gas facilities, some companies with natural gas supply maintaining manufactured and/or LPG plants to supply supplemental fuels for peak-time use, peak shaving, and standby purposes. Gas mixing techniques becomes fundamental to operations.

Gas mixing is also a fundamental operation in many industries; therefore, the industrial sales engineers for operating utilities must know and apply scientific gas making principles.

It is obvious that gas mixing is done to produce a more usable fuel. The proper solution of a gas mixing problem will, therefore, involve the measurement of certain variables, and must be based on some final control of one or more of these variables. There are a number of factors of the gases being mixed and the final mixed gas which can be measured and could form a basis for a solution to a specific problem. Some of the most important are:

1. Volume.
2. Density or specific gravity.
3. Combustion characteristics.
4. Heating value.

These and other characteristics of the gases involved are important in the production and utilization of gas fuel. Two factors are of paramount importance by virtue of the normal use of gas. Since gas is used primarily as a source of heat energy, the *heating value* and *volume* certainly represent the most important quantities involved. The volume required will be determined by demand, so the gas mixing control system must be designed to fulfill this requirement. Then, the *mixture heating value* will become the final criterion of operation.

Heating value is easily and reliably measured, continuously and automatically. This is the reason for its selection as the final factor in mixing control.

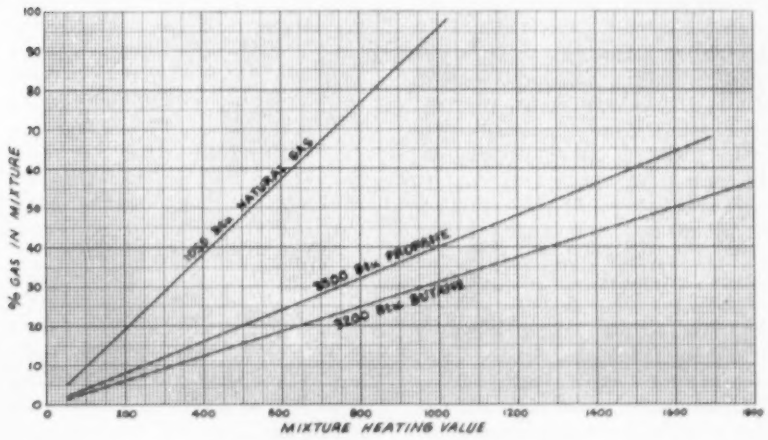


Fig. 1. Composition of gas-air mixtures.

It is true that other gas characteristics must be considered in determining the final control factor, but in practically every instance, by controlling on the *basis of mixture heating value*, and including certain modifications of this control, the desired final result can be secured in the most reliable way possible. In most cases, the production of a mixed gas of constant heating value results in maintaining other gas characteristics within limits that give the desired result. In fact, gas mixing control on the basis of *final mixture heating value permits closer control* of gas characteristics than control based on other factors because of the precision and reliability of continuous recording calorimetric equipment. The following illustration is an example.

Suppose it is desired to produce a propane-air mixture as a substitute for natural gas. The mixture desired is assumed to be 1300 Btu. Thus:

$$2550X = 1300$$
$$X = 51\% \text{ propane}$$
$$1\text{-}X = 49\% \text{ air}$$

(See equations 1 and 2.)

and the specific gravity (air = 1) becomes:

$$0.51 \times 1.527 = 0.779$$
$$0.49 \times 1.0 = 0.49$$
$$1.269$$

Then, assume a change of 10% in the heating value of the mixture. In this case, the new heating value will be 1300 + 130 = 1430 Btu, and the mixture would be:

$$2550X = 1430$$
$$X = 56\% \text{ propane}$$
$$1\text{-}X = 44\% \text{ air}$$

Consequently, the new specific gravity will be:

$$0.56 \times 1.527 = 0.855$$
$$0.44 \times 1.0 = 0.440$$
$$1.295$$

thus, the specific gravity change is

$$\frac{1.295 - 1.269}{1.269} = 2.05\%$$

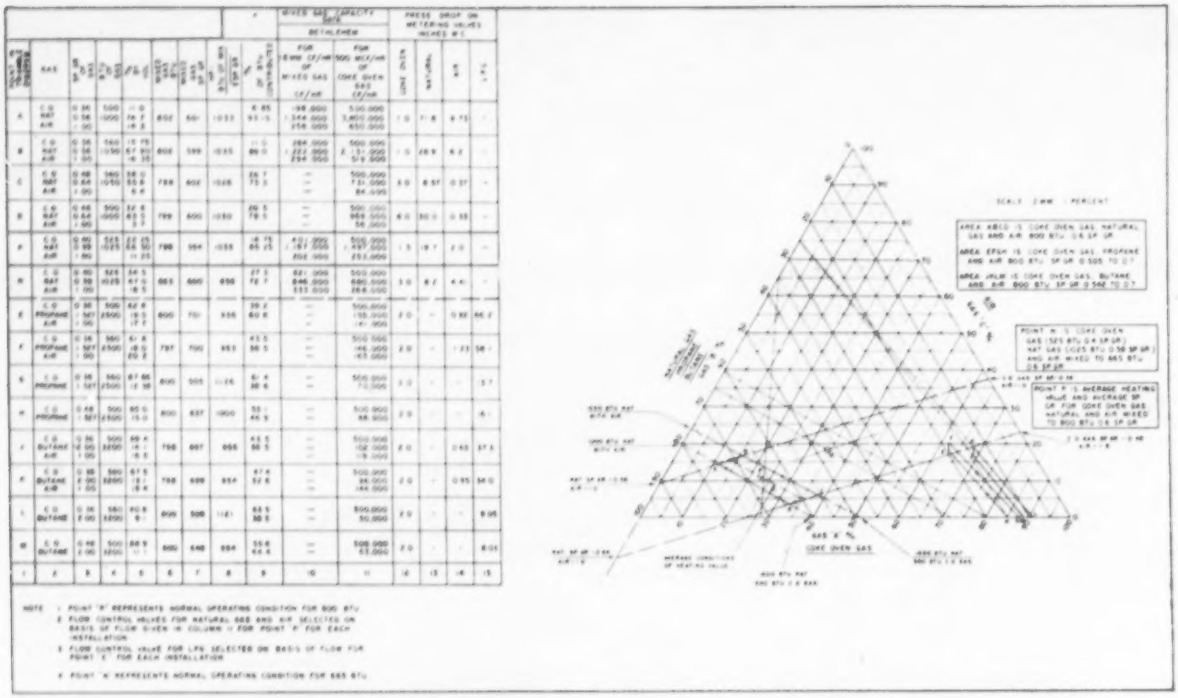


Fig. 2. Triangulation diagram for three gases — with tabulation of points

Therefore, if final control was based on specific gravity, a 2% change in this factor would cause a 10% change in mixture heating value. The increased difficulty in securing the proper control of the final mixed gas is obvious.

In general, a gas mixing control consists of three elements:

1. Some system of *volumetric proportioning* to establish and maintain an approximate proportion of the constituents, in the final mixture, for the complete range in send-out requirements.

2. Proper *calorimetric equipment* to indicate and record the mixture heating value and to permit automatic control of the value to some preselected point. The calorimetric control equipment is required not only to correct the proportioning system to compensate for changes in the heating value of the constituents, but also to correct for errors in proportioning which can result from incorrect metering.

3. A *Btu adjusting mechanism* which is the device coupled to the volumetric proportioning equipment which will cause changes, under the direction of the calorimetric equipment, to the proportioning in order to hold the final mixture at the desired point.

The time lag in obtaining accurate calorimetric determinations is the primary factor which makes gas mixing control difficult. The control of many quantities such as pressure, temperature, speed, voltage, or current is comparatively simple, since the instrument indicating the property to be controlled responds almost instantly to the condition at the point where control is desired. It is, therefore, relatively simple to correct for undesirable variations at the point to be controlled, and anti-hunting schemes are only required to overcome the inertia of the system. In gas mixing, incorrect mixtures may continue to pass into the system during the time lag in obtaining the heating value determination. In addition to the foregoing objection, the time lag of accurate calorimetric instruments is sufficiently large so that many anti-hunting schemes are entirely unsuited for gas mixing control because the follow-up system would introduce variations in average heating values which would prove to be more objectionable than hunting with the correct average heating value.

The ease with which gas mixing can be controlled depends to a great extent on local conditions which can be summarized as follows:

1. Sendout requirements.
2. Available plant equipment.
3. Final mixture heating value, and heating value of the constituent gases.

Under *sendout requirements*, the factors of prime importance are permissible variations in heating value and variations in rates of gas demand. The permissible variations in heating value, particularly on the low side, are frequently determined by local or state ordinances. With the requirements for efficiency in operations, economic reasons will also determine and limit permissible variations. In considering variations in mixture heating value, it may be necessary to differentiate between instantaneous variations, or changes for very short periods of time, and variations in average heating value over a longer, fixed period. The presence of holders or other intervening capacity between the mixed gas sample point and the first consumer will have an important bearing on this question.

Changes in gas demand materially affect gas mixing control problems. With a comparatively uniform demand for mixed gas, control is relatively simple. Where sudden large variations in gas demand must be handled by the mixing control, porportioning equipment which provides approximately the proper proportions of the constituents is required.

The available plant equipment and method of operation will also have a bearing on the solution of the problem. The operation of compressors, possibility of pulsations adversely affecting flow measurement, the required pressure of the mixed gas, availability

of storage holders, effect of extreme weather conditions, and general plant piping all require consideration in the design of the correct gas mixing control system.

The desired mixture heating value and the heating value of the constituents will have a decided bearing on the complexity of the problem. A particularly difficult control problem arises when the heating value of one of the constituents follows a cycle with a period comparable to the time lag of the calorimetric controller. Sometimes, variations in specific gravity and temperature of the constituent gases introduce problems in proportioning which must be given consideration.

In many instances, it is possible to set up mathematical equations to determine the effect of these variables so that a quantitative of a specific problem can be secured. With this information, the selection of a control system and its components can be made on a sound basis rather than depending solely on judgment and past experience.

In order to satisfactorily design a gas mixing control system it is necessary to know the percentage of each constituent in the desired final mixture.

For two gas mixtures the general expression in terms of heating value is given by the following equation:

$$H_r (X) + (1 - X) H_L = H_M \qquad (1)$$

where—

H_r = Heating value of rich gas

X = Decimal part volume of constituent H_r

H_L = Heating value of lean gas

H_M = Heating value of desired mixture.

$100X$ = % by volume.

If the mixture is to be gas and air the formula can be simplified to:

$$H_r (X) = H_M \qquad (2)$$

where—

X = Decimal part volume of gas;

then,

$1\text{-}X$ = Decimal part volume of air.

Fig. 1 shows some composition curves for typical gas-air mixtures.

For three gas mixtures, a graphical solution in the form of a triangulation plot represents a very convenient method of analysis. *Fig. 2* shows a triangulation diagram (plot in triangular coordinates) for a specific problem. In this illustration, the final mixture is to consist of natural gas, coke oven gas, and air, at 800 Btu and a normal gravity of 0.6.

The construction of the diagram was made from the following data:

Natural Gas

Heating value 1000 to 1050 Btu, normal 1025.

Specific gravity 0.56 to 0.64, normal 0.59.

Coke Oven Gas

Heating value 500 to 560 Btu, normal 525.

Specific gravity 0.36 to 0.48, normal 0.38.

Maximum flow 500 Mcf/hr.

Air

Mixed Gas

Heating value 800 Btu.

Specific gravity 0.6.

Maximum flow required 1.8 MMcf/hr.

Minimum flow required 180 Mcf/hr.

On the triangulation diagram, the following designations are used:

Axis A—This horizontal line represents the percentage of coke oven gas, with the left end as 0% and the right end as 100%.

Axis B—The line sloping upward to the right represents the percentage of natural gas, with the lower end as 100% and the upper end as 0%.

(Note: This axis can also be used to represent the percentage of propane or butane when these are substituted for the natural gas.)

Axis C—This line sloping upward to the left represents the percentage of air, with the lower end as 0% and the upper end as 100%.

On the "A" axis, two points are shown which represent the mixture of natural gas and coke oven gas to 800 Btu. For example, one point is for natural gas of 1000 Btu mixed with coke oven gas of 500 Btu to a mixture of 800 Btu.

Similarly on the "B" axis, two points are shown which represent the mixture of natural gas and air to 800 Btu.

Thus, the area within the polygon outlined by these four points represents all of the possible combinations of the three constituents which will give a final mixture heating value of 800 Btu.

It is also possible to show the specific gravity data on this same diagram as follows:

Since the left-hand corner of the triangle is 100% natural gas, 0% coke oven gas, and 0% air—it represents a specific gravity in the range from 0.56 to 0.64. Similarly, the apex of the triangle is 100% air, and 0% coke oven gas and natural gas—representing a specific gravity of 1.0. Using the 0.56 and 1.0 values, 0.6 specific gravity will lie along axis "B" and will be:

$$100 \; .1 - 0.56 = 0.44 \times 100 = 9.08 \; \frac{0.6 - 0.56}{0.04}$$

divisions up from the lower left hand corner of the triangle. This point is shown on the diagram. Using the 0.64 and 1.0 values, 0.6 specific gravity will also be on axis "B", but 11.1 divisions down from the lower left-hand corner of the triangle. This point is also shown on the diagram.

In a similar maner, two points of 0.6 specific gravity for mixtures of coke oven gas and air can be located along axis "C", remembering that the lower right-hand corner of the triangle is 100% coke oven gas, and 0% air and natural gas.

By connecting the points of 0.6 specific gravity, a polygon will be described within which all the possible combinations of the three constituents which will give a final mixture of 0.6 specific gravity will be found.

Then, the common area of the mixture heating value polygon and the mixture specific gravity polygon, shown on the diagram as the region outlined by points A, B, C, and D, will contain all of the combinations of the three constituents which will give a mixture heating value of 800 Btu and a specific gravity of 0.6. Point P, within this area, corresponds to average conditions of heating value and specific gravity for the constituents.

The necessity and importance of volumetric proportioning equipment as part of the gas mixing control can also be evaluated mathematically. In this case, an expression of the change in flow of either constituent in a two gas mixture to produce a fixed change in mixture heating value, is desired. For the sake of uniformity, and on the basis that a 1.0% change in mixture heating value is a good criterion of performance, the following equations apply:

$$\Delta F_r = \frac{H_M}{X (H_R - 1.01 H_M)} \qquad (3)$$

where—

ΔF_r = Percent change in flow of rich gas, H_R, to produce a 1% change in mixture heating value, H_M;

and,

$$\Delta F_L = \frac{H_M}{(1 - X) (H_L - 1.01 H_M)} \qquad (4)$$

where—

ΔF_L = Percent change in flow of lean gas, H_L, to produce a 1% change in mixture heating value, H_M.

The importance of this factor in gas making problems is illustrated by *Fig. 3*. It can be seen that all usual mixtures of propane or butane-air are very critical proportioning problems. For example, with a 100 Btu propane-air

mixture, an error in flow of the propane gas of 1.04% will cause an error of 1% in the mixture heating value. Since this heating value corresponds to the mixture heating value for premix gas, it can be seen that if any flow measurement is involved in proportioning the gas and air, it must be very accurate if desired heating value is to be maintained. Similarly, in producing standby propane-air mixture of 1300 to 1400 Btu, ΔF_r for such a mixture is only about 2%. This would also require very accurate metering and control for the proportioning system.

In the case of natural gas-air mixtures, the proportioning problem is not the same. For premix gas, the proportioning problem is very critical since ΔF_r is about 1.1%. However, in stabilizing natural gas to 1000 Btu, ΔF_r becomes relatively large, about 25%, indicating that the proportioning problem is not difficult.

It will be found that the value of ΔF for the lean gas does not have exactly the same value as that for the rich gas, so both figures should be determined in analyzing the problem.

Another example may serve to illustrate the value of this calculation. Suppose it is desired to mix natural gas of 1050 Btu with manufactured gas of 450 Btu to produce a mixed gas of 800 Btu.

$$1050X + (1-X)\ 450 = 800$$
$$600X = 350$$
$$X = 58.4\% \text{ Natural gas}$$
$$1-X = 41.6\% \text{ Manufactured gas.}$$

Then—

$$\Delta F_r \text{ (Natural)} = \frac{800}{.584\ (1050 - 1.01 \times 800)} = 5.65\%;$$

and,

$$\Delta F_L \text{ (Manufactured)} = \frac{800}{.416\ (450 - 1.01 \times 800)} = -5.36\%.$$

The results indicate essentially the same precision of measurement required for each constituent. The negative sign for the value of ΔF_L merely indicates the opposite affect on the mixture heating value. In other words, an increase in flow of the manufactured gas of 5.36% will reduce the mixture heating value by 1%.

It is also very important to determine the effect of changes in the mixture heating value which will result from changes in the heating value of the constituents. Again, on the basis of a two gas mixture, the following equations apply:

$$\Delta H_r = \frac{H_m}{X\ (H_r)}, \qquad (5)$$

Where ΔH_r is the percent change in heating value of H_r, which will produce a 1% change in the mixture heating value.

Similarly,

$$\Delta H_L = \frac{H_m}{(1-X)\ H_L}, \qquad (6)$$

Where ΔH_L is the percent change in heating value of the lean gas, H_L, which will produce a 1% change in the mixture heating value.

In the case of gas-air mixtures, it will be found that a 1% change in the gas heating value will produce a 1% change in the mixture heating value. For example, in the case of a 1300 Btu propane-air mixture:

$$2500X = 1300$$
$$X = 52\% \text{ propane}$$
$$1-X = 48\% \text{ air}$$
$$H_r = \frac{1300}{.25\ (2500)} = \frac{1300}{1300} = 1\%$$

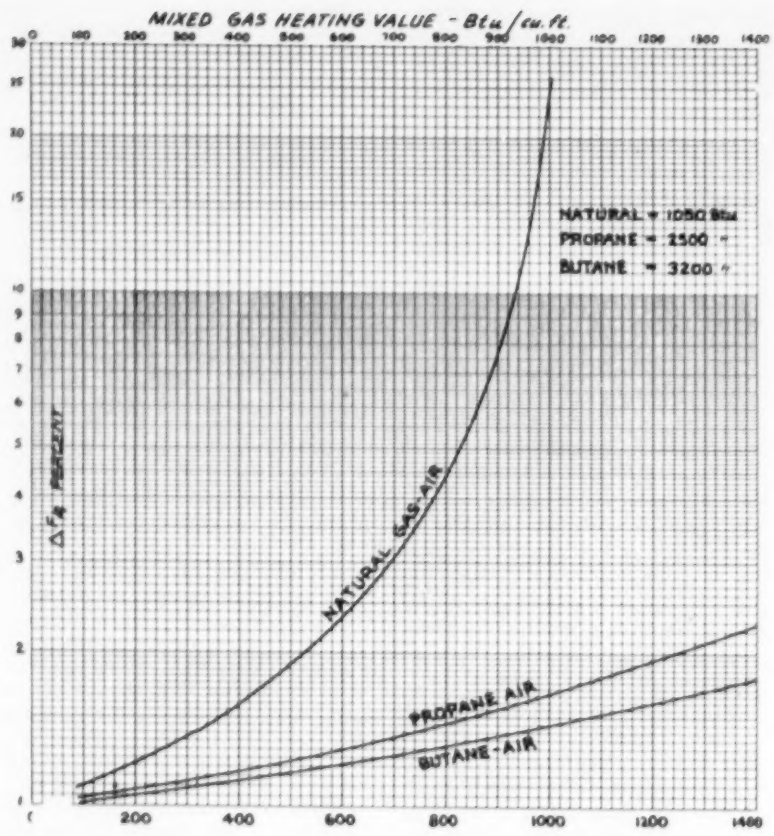

MIXED GAS HEATING VALUE - Btu / cu. ft.
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400
NATURAL = 1050 Btu
PROPANE = 2500 "
BUTANE = 3200 "
ΔFR PERCENT
NATURAL GAS-AIR
PROPANE-AIR
BUTANE-AIR
200 400 600 800 1000 1200 1400

Fig. 3. Curves of delta F sub-R for gas-air mixtures.

However, in the case of the natural gas manufactured gas mixture given previously,

$$\Delta H_r = \frac{800}{.584\ (1050)} = \frac{800}{613} = 1.3\%;$$

and,

$$\Delta H_L = \frac{800}{.416\ (450)} = \frac{800}{187.5} = 4.26\%$$

In this mixture, a 1.3% change in the natural gas heating value will change the mixture heating value by 1%, and a 4.26% change in manufactured gas heating value will cause a change of 1% in the mixture heating value. ■

In Part 2, *Mr. Warner describes the equipment that can be used to produce the fundamentals of a gas mixing control system; that is, the volumetric proportioning system, the calorimetric equipment, and the Btu adjusting mechanism. Instrument time lag and its relation to good gas mixing control will be discussed in detail.*

Fig. 1. Work schedule blackboard (left) mounted in the construction and maintenance superintendent's headquarters at Southern Union's offices in Albuquerque. Though not clear in the picture, those trucks equipped with VHF mobile radio, have this so indicated under the truck number. Fig. 2. Construction foreman erases a work order address (right) to indicate the work has been completed.

Schedule board expedites gas service orders

IT'S the same old story out in Albuquerque, N. M. — that is, it's the story that gas distribution men are used to hearing — the city has been growing at such rapid rate during the last decade that the utility companies have been hard pressed to keep up with the expansion. In 1948, Southern Union Gas Co. was 2500 service orders behind. The only answer to this problem was to increase the efficiency of handling service orders. The schedule board is a simple, unspectacular — but very useful — device that has helped increase the efficiency to whip this problem.

All of the service orders for Albuquerque are accepted by the commercial office. They are processed there and sent to the chief distribution clerk. This man has four books containing one or more sheets for each street in the local system; he notes the name of the customer, the address, and the date received. The orders are then routed to the drafting room for such information as main location, size, pressure, and so forth. Next, orders are returned to the clerk who files them or gives them to the construction and maintenance superintendent as required or as indicated by requests from the customers.

The construction and maintenance superintendent usually has from 50 to 200 orders on his desk in addition to the orders that the crews are working. The superintendent obviously could not remember all the orders that the crews have out working, since there are 12 crews and each usually has from six to nine orders. He therefore devised a blackboard to help him.

This board is about 12 ft long and 5 ft high, divided in the middle along its length and into sixths vertically, thus providing 12 spaces (see *Fig. 1*). Each space has a foreman's name and truck number (the word "radio" is used where applicable) at the top and nine divisions below to list the addresses of the orders. Permanent spring clips are secured at each foreman's name for attaching messages relating to the jobs or to the welfare of employees under his supervision.

Each night when the foremen come in, they erase the addresses of the work completed that day (see *Fig. 2*). Each morning ,the construction and maintenance superintendent comes in about one-half hour early. He surveys the work completed, the work remaining, and then assigns new orders to the various people who need them. Foremen write their orders on the board in the approximate order in which they intend to do the work (see *Fig. 3*).

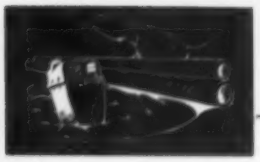
With this board, the construction and maintenance superintendent can tell at a glance what work is in progress, what work will soon be done and he can roughly plan his work two or three days in advance. In addition, the clerical staff can easily answer telephoned inquiries from the customers.

The distribution system in Albuquerque extends 22 miles north, 12 miles east, 15 miles south and 6 miles west of the service terminal. In the event of an emergency, such as a broken main, a quick look at the board will tell where to go to find the nearest crew to start repairs in the shortest time. Similarly, we frequently have emergency calls for some worker whose family has suffered an accident or sudden illness, and once again, by using the board, this man can easily be found.

We have been using our board for about seven years now, and we know we certainly could not do without it. ■

Fig. 3. Here, construction foreman has received his work orders for the day, he has analyzed them, and is now writing them on the work schedule board in the approximate order he will service them.

GAS exclusive



Consumers Power solves a materials handling problem

...How to move meters

By A. W. RAUTH • Consumers Power Company

THE centralization of any meter operation immediately presents the problem of meter transportation. Naturally it means the handling of a considerable number of meters daily and the transportation of some meters a rather great distance. The most efficient manner of handling meters may not be available at all locations where they are picked up and delivered. Economics may prevent the use of modern equipment to do such handling.

To meet the above mentioned problem, the Consumers Power Co., Jackson, Mich., has made use of cargotainers somewhat different from the standard equipment. Containers suitable for holding both gas and electric meters were necessary since the Consumers Power Co. is a combination company. The main difference between the containers used by Consumers Power Co. and standard equipment is that the Consumers Power equipment is provided with legs on both ends suitable for stacking and with swivel wheels at one end. A tongue is provided at the end opposite the wheels so that a dolly may be used to lift the container from the legs and thus make is movable by use of the wheels on the dolly and the swivel wheels.

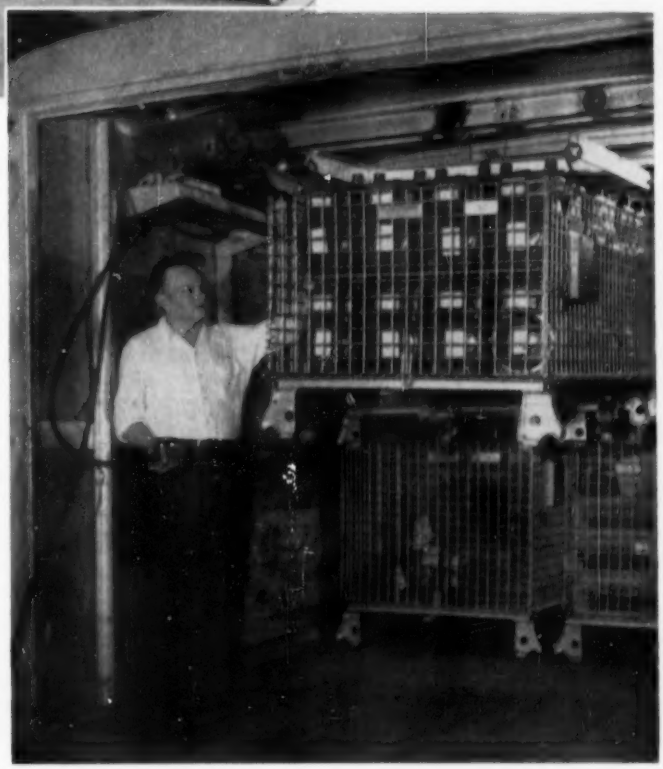
When the dolly is not in use, the container sits level with the floor, one end resting on the swivel wheels and the other end on two legs. When the dolly is used, the tongue end of the container is lifted approximately ¾ in. from the floor, thus holding it at a slight angle.

Special container loaded with ironcase gas meters is handled with a dolly at a Consumers Power warehouse. Meter record cards are placed in sheet metal box on the side of the container.

The swivel wheels and a dolly would not be required if fork lifts were available at all loading and unloading docks. Unfortunately, only three of the eleven locations throughout the Consumers Power system at which the containers are loaded and unloaded are provided with fork lift trucks.

Transportation of meters between the divisions and the general meter building is done by means of tractors and semi-trailers. These trailers are completely enclosed to protect the meters from weather. To make use of all of the space in the trailer it is necessary to stack the containers. This makes it possible to haul 26 containers in a load. The containers are approximately 40 in. x 48 in. inside and are of two heights, 24 in. and 32 in. inside. These heights

Fork lift truck (left) stacks a container of tincase gas meters. Consumers Power is a combination company, so a variety of meter sizes must be handled with the special containers.



Small electric-powered hoist handles a loaded container with ease inside trailer of semi-trailer truck typical of those used to move meters between divisions and general meter building. Trailers are also equipped with hydraulic-power tail gates.

were governed by the electric meter transportation and not the gas.

Since many of the headquarters for loading and unloading are not provided with the necessary dock arrangement or fork lift, it is important that the containers can be moved with the dolly. Since containers filled with cast iron meters and stacked one on the other become rather heavy, it is again impractical to move the containers more than a short distance with a dolly.

Each trailer is provided with a hydraulic tail gate, so it is practical to roll a container on the tail gate, drop the gate by means of the hydraulic lift, and roll the container on whatever platform is available. This arrangement worked out very well except that it did not provide a means of completely loading the trailer in locations where there was no means of stacking the containers. To overcome this difficulty, an electrically driven hoist has been mounted in the roof at the rear end of each trailer. An extension cord is permanently fastened to the motor of the hoist so that it can be plugged in a 120-volt convenience outlet. The hoist is suitable for lifting approximately 2000 lb.

To unload the trailer in locations where a fork lift is not available, the two stacked containers are moved under the hoist by means of the dolly. The shallow container (which is always stacked on the deeper container) is lifted from the deeper container by means of the electrically operated hoist and is left in the raised position. The hoist is provided with a magnetic lock which will hold the container in any position it happens to be in when the motor is deenergized. The deeper container is then rolled on the tail gate, the tail gate lowered to the floor level, and the container removed from the tail gate by means of a dolly. The tail gate is then raised so that it is level with the floor of the trailer and the shallow container is lowered to the floor by means of the hoist. Then the container is moved on the tail gate by means of the dolly and the tail gate is lowered to the floor level. To load the trailer, the reverse operation is followed. One container loaded or unloaded can be moved easily on a level floor without the aid of a fork lift. This eliminates providing extra fork lifts in many operations.

Each container is provided with a designating number which appears on a metal strip at either end of the container. On one side of each container is a small metal box with a lid. Whenever a container leaves the division or the general meter building, a card for each meter in the container is placed in the box. These cards are used for accounting purposes. ■

A novel approach to maintenance and replacement problems

By B. A. MARGO
Consulting Management Engineer

THE method outlined in this article should be of interest to the executives in the gas industry who are concerned with improvements and savings in the field of maintenance and replacements. Its installation is a once occurring effort which is small relative to the benefits that may be derived from it; the running expense is negligible. The main feature of the method is that it makes detection of excessive maintenance costs a simple, automatic routine using an objective measuring stick. The consequent ramifications can produce the following advantages:

1 — *Maintenance expense* may be reduced because the method provides a positive measure of excessive maintenance costs. This means not only that supervisors will be in a position to stop repairs *after* they went over a certain limit, but also *before* this limit has been reached.

2 — Conversely, the method might help to utilize *capital investment to better advantage* for it may prevent an occasional premature replacement.

3 — It may produce various control figures for *a well balanced replacement program.*

4 — These control figures would also help to *adjust a maintenance budget* to changing conditions.

5 — Companies will be in a position to establish maintenance budgets for selected *groups* of machines, etc., (in the following called "units") or for all units of a department.

6 — It will establish *set schedules* of inspections and repairs as well as overhaul jobs even for units not previously used. This is important to systems of planned maintenance.

7 — The reporting set-up will give a clear-cut splitup between technical and administrative functions which should result in better utilization of the personnel in question.

8 — Maintenance records (history cards) will become *measuring tools* of new significance.

9 — It will produce valuable data for determining priorities for planned maintenance.

Range of applications of the new method

The method may be applied to *anything that has to be maintained:* pipe lines, meters, buildings and their component floors and roofs, compressors, construction equipment, hydraulic drives, communication systems, gas engines, electric motors and equipment, fans, gas cleaners, coating and wrapping machines, gas producing equipment, valves, pressure regulators, instruments, etc. It is advisable to apply the method not only to those units for which a company has history cards, but also to their components if they may present an individual replacement problem. How far this is extended in this respect depends mostly upon the time and money available to keep these records.

Many units are replaced for seasons which have little or nothing to do with maintenance costs: the new unit may save money because of greater production, or it is safer or for other reasons. Still, it might be practical to apply the method to *all* units subject to a maintenance budget. To set a limit of monthly maintenance expense for every unit is a kind of *insurance* that any excess will come to the controlling person's attention automatically, and such excesses may happen with units where this would not be expected. This is true, particularly, because the new method gives for the first time a clear definition of excessive maintenance costs.

The reasoning behind the new method in broad terms

One of the basic conceptions in the design of the new method was that the usefulness of history cards could be greatly enhanced if they would indicate when maintenance costs become excessive. Sometimes this fact is quite obvious; however, there exist innumerable instances where different opinions are feasible. Consequently, units are either discarded before necessary (from the viewpoint of excessive maintenance as defined in the following) or repairs are continued for obsolete units. This means, in the first case, that the capital investment is not utilized to best advantage—a hidden loss—in the second case, that money is wasted. To have a measuring stick based on facts of a technical nature should be instrumental in eliminating these losses.

The facts selected are the following:

1 — the value of the unit,
2 — the operating conditions and
3 — the maintenance budget.

Actually, the new method formulates only what any good maintenance man does instinctively. He knows that a valve working under adverse operating conditions requires more maintenance than one working under more favorable conditions. Consequently, he is willing to spend more for its maintenance, and further, he is prepared to spend less for the maintenance of a valve costing $50 than for maintenance of one costing $2,000, but he still has to "live" within his maintenance budget (called "budget" hereafter). This budget is normally the only source of money

he can spend. Whether this budget is "too high" or "too low," for any reasons, does not make any difference as far as the new method is concerned. The budget is accepted as such and is used to establish one of the basic figures. If, for instance, the budget is $30,000 per year and the total investment to be maintained $500,000, we calculate:

$$\frac{\$\ 30{,}000}{\$500{,}000} \times \frac{1}{12} = 0.005$$

which is the average budget dollar per dollar invested, on a monthly basis.

Fig. 1 (see page 47) shows how the budget ties in with the different phases through which units normally pass till they are replaced.

The upper line shows the phases; the lower one the corresponding maintenance costs. The "Limit" is reached at the end of the useful life (useful from the viewpoint of maintenance costs), that is the time when maintenance costs become excessive according to the conceptions of the new method.

It can be said that the limit should be reached, for instance, when the maintenance costs of a unit reach double the average. However, the limit may be set higher or lower as desired. There are no statistics available at this time to determine where the limit should be set for the infinite number of enterprises to which the new method is applicable. Double the average looks reasonable. Using the figures given in the budget this could be used to obtain a constant for all units of

$$2 \times 0.005 = 0.01$$

This would be the limit for a unit of the value $1 operating under average operating conditions. This means that the maintenance costs of such a unit may be allowed to reach $0.01 per month before they are considered excessive.

All that is needed now is a means of determining operating conditions with one figure. This figure is called Wear Factor, and may be calculated using a Table of Wear Points. (See *Table 1.*) Take the Wear Points from this table and multiply them with each other; this computation leads to the Wear Factor for the unit. Then, total up all Wear Factors and divide the total by the number of Wear Factors. The result is an average Wear Factor, the figure which measures the average operating conditions mentioned above. If the individual Wear Factor is applied in relation to this average, Wear Ratios per unit are obtained, and these tell whether a unit is subject to more or less wear than average. With these data, the limits for each unit can be calculated; for instance, for Unit No. 1 of *Table 2:*

$$\$17{,}500 \times 0.01 \times 0.12 = \$21$$

where $17,500 represents the value, 0.01 the constant, and 0.12 the Wear Ratio.

The new reporting set-up

These limits should be written on the heading of history cards so that the clerk in charge of these cards may be able to detect whether a unit went over the limit when making his monthly entries. If so, he should bring this to the attention of the maintenance engineer. The latter should then investigate whether the unit went over the limit permanently or not. (Perhaps it did so incidentally because of a rush repair job or lack of proper spare parts). If he is convinced that the unit will stay over the limit, he should report to the executive directly responsible who, in turn, should investigate whether the unit should be replaced or not, and when. The latter decision will depend upon the book value of the unit, its replacement price, the urgency of replacement relative to other purchases contemplated, the financial position of the company, and similar considerations.

This set-up breaks down a very complex situation into two phases which can be handled more efficiently: the first phase is detecting an excess expenditure and its investigation, which is a purely technical affair; the second phase is making a decision which requires administrative knowledge and ability. It stands to reason that this set-up should make life easier for those concerned.

It should be mentioned that the notation of limits on history cards may not only be used to detect when maintenance costs became excessive, but also to prevent this. If a unit's breakdown requires a large repair job, and providing it is not to be put back into operation immediately, the maintenance engineer can review the history card and check whether the repair costs would bring the unit over the limit or not—(prorating of large costs will be discussed). Accordingly, he may (occasionally) be in a position to prevent maintenance costs from becoming excessive.

How to set up a table of wear points

Table No. 1 is a specimen only. The Wear Points are arbitrary values. For

TABLE No. 1 — TABLE OF WEAR POINTS

Operating Condition	Item No.	DEGREE							
Usage	1	1 shift		2 shifts		3 shifts			
		1-1	1.2	1-2	2.6	1-3	4.0		
Load	2	constant		slight fluct.		cont. fluct.		repeated shocks	
		2-1	1.2	2-2	1.7	2-3	2.4	2-4	3.6
Vibration	3	none		slight		medium		severe	
		3-1	1.0	3-2	2.0	3-3	3.0	3-4	4.0
Head or Pressure, Stress	4	small		medium		high			
		4-1	1.1	4-2	1.3	4-3	1.6		
Capacity	5								
		5-1		5-2		5-3			
Corrosion	6	none		small		medium		severe	
		6-1	1.0	6-2	1.2	6-3	1.6	6-4	2.5
Abrasive Content, Abrasion	7	none		little		medium		high	
		7-1	1.0	7-2	1.2	7-3	1.4	7-4	1.7
Temperature degrees F	8								
		8-1		8-2		8-3		8-4	
Temperature fluctuation	9	negligible		gradual		sudden			
		9-1	1.0	9-2	1.3	9-3	2.5		
Velocity	10	small		medium		high			
		10-1	1.1	10-2	1.2	10-3	1.3		
Erosion	11	none		small		medium		high	
		11-1	1.0	11-2	1.1	11-3	1.5	11-4	2.0
Use outdoors	21	summer		winter					
		12-1	1.2	12.2	1.4				

NOTE: It is advisable to define expressions as "small," "medium," etc., by means of concrete data wherever feasible and to collect such data in a manual.

TABLE No. 2

Unit No.	Value $	Wear Factor	Wear Ratio	Monthly Limit $
1	17,500	4	.12	21
2	23,500	25	.74	174
3	45,000	17	.51	230
4	96,000	49	1.46	1,400
5	105,000	65	1.93	2,025
6	67,500	28	.83	560
7	48,000	36	1.07	513
8	65,000	55	1.64	1,066
9	10,500	44	1.31	138
10	22,000	13	.39	86
Total	**500,000**	**336**		**6,213**
	Average	33.6		

an individual gas company's purposes, it may be necessary to enlarge or to condense the table. Wear Points may be determined by various means: according to the judgment of good maintenance men; using data from text books, trade journals or other authoritative publications; making laboratory tests; checking reliable maintenance records; or a combination of all these. It may be hoped that such tables will be published for different industries and that progressive manufacturers will supply the Wear Factor with the unit to please the harrassed maintenance engineer. However, primarily operating conditions are of prime concern rather than absolute values. This limits the task considerably. It is suggested that a start be made using the extreme degrees of the operating conditions experienced. Then, pick the intermediate values as a more or less straight line function. These values should be a measure of the wear of a whole unit or its most significant parts.

It is advisable to establish first of all the wear factor for the unit subject to the greatest wear. This will give an opportunity to check the reliability of wear points, based as the project progresses on the graph (see *Fig. 2*). This graph is based on the observation that intervals between inspections and overhaul jobs depend mostly upon operating conditions. The latter are expressed by means of Wear Factors. When the determinations have been made for the Wear Factor and the interval of overhaul jobs for the unit subject to greatest wear, the point of the curve farthest to the right can be plotted. Then, the curve can be extended backward without trouble.

How to calculate wear factors

Select the Wear Points applicable and multiply them by each other. Example:

Reference No.	Wear Points
1-1	1.2
2-4	3.6
3-4	4.0
4-1	1.1
5-2	1.4

Multiplying these Wear Points by each other (1.2 x 3.6 x 4.0 x 1.1 x 1.4) produces a Wear Factor of 26.6, say 27.

If several units of the same type are subject to similar operating conditions (meters, valves), it is necessary to calculate the Wear Factor for the type only.

To obtain reliable results from the new method, it is advisable to adjust the prices of units bought some years ago according to the purchasing power of the dollar of today. To this end—unless a better system can be devised—the conversion factors shown in *Table No. 3* can be used. These factors are derived from the Consumer's Price Index as published by the Bureau of Labor Statistics, based on 1935 - 1939=100.

If the original price cannot be determined or if it is difficult to set values for components like floors, suppliers can usually provide the information.

A suggestion for prorating large costs

Any relatively large expense for repairs, if dumped into the month when the payment occurred, is liable to bring a unit prematurely over the limit. Such costs should be prorated approximately over the period for which the repair should be good. *Fig. 3* (page 48) should reveal the principle of prorating.

It is worth while to ascertain that the notations on history cards conform with the costs contained in the budget. Budget may comprise maintenance, labor, and material; and also the salaries of the supervisory personnel, clerks in the maintenance office and stock room for spare parts, machine shop maintenance etc. Accordingly, the constant 0.01 would include these costs. This "overhead" of the maintenance department might be a substantial percentage of labor and/or material costs and can normally not be neglected on the history cards. This means that this "overhead" should be added once a month on the active cards in form of a percentage figure perhaps added to maintenance labor.

After doing this, the figures shown

TABLE No. 3

Year	Index No.	Conversion Factor	Year	Index No.	Conversion Factor
1935	98.1	1.96	1945	128.6	1.49
36	99.1	1.94	46	139.5	1.38
37	102.7	1.87	47	159.6	1.20
38	100.8	1.90	48	171.9	1.12
39	99.4	1.94	49	170.2	1.13
40	100.2	1.91	50	171.9	1.12
41	105.2	1.82	51	185.6	1.04
42	116.6	1.65	52	189.8	1.01
43	123.7	1.55	53	191.3	1.00
44	125.7	1.53	54	192.1*	1.00

*estimated

Example: A unit costing $100 in 1945 might cost about 1.49 x $100 = $150 today.

new	up to average	average	over average	end of useful life	should have been replaced
small	up to average	average	over average	"LIMIT"	excessive
BUDGET					

Fig. 1. Budget ties-in with flow of replacement units.

on the history cards may be used for cost accounting purposes — a point worth considering.

How often should limits be changed

This should happen very rarely and only under the following conditions:

1 — whenever operating conditions change substantially and permanently;

2 — if the budget should be changed substantially and permanently, but independently of a change in purchasing power of the dollar.

The expressions "substantially" and "permanently" are relative and depend upon judgment.

Changes of purchasing power of the dollar should normally not affect the limits since they are based on a constant which contains the quotient budget divided by investment. If the budget has to be changed because of changing purchasing power of the dollar, it may be assumed that the replacement cost of the units in question change approximately in the same proportion. Consequently, the quotient would remain practically unchanged.

If an advantage in an overall budget is observed, there may be interest developed in budgets for groups of similar units or, alternatively, for all units of specific departments, or both. Such budgets may be established by means of actual maintenance data; however, the new method may be used to replace or to supplement this actual experience. If a budget of $30,000 per year is again considered with a total of all limits amounting to $6,231 (see page 46, *Table 2*), it is reasonable to assume a total limits for the group amounting to $2,500, or 40% of $6,231. Then a figure of 40% of $30,000 = $12,000 can be established as group budget. This approach is based on the assumption that — everything else being equal — maintenance costs depend upon values and operating conditions. These data, in turn, are expressed in one figure: the limit.

This method of establishing group budgets, however, is applicable only if all conditions (operating conditions, physical condition of the units, maintenance cost per dollar invested) are about average or if a fair allowance can be made if this is not the case. This reservation is needed since the calculation of limits (used for calculating group budgets) depends upon the constant 0.01 which is an overall average.

Why not use the new method to establish a budget?

This is a question that is often voiced. The explanation of why this isn't practical follows. A budget—unless it has been established arbitrarily—reflects a natural development of great complexity. It grows with the number of units to be maintained; with rising labor and material costs as well as maintenance "overhead"; with the increasing demand from operating people to have fewer breakdowns; perhaps it was lowered occasionally by improving maintenance methods (planned maintenance, better control of spare parts). The new method, on the other hand, has not been designed to answer the question how much money has to be spent to take care of these complex conditions. It takes the budget as a given figure without questioning its validity and keeps all calculations and deductions in the frame work of the budget.

Under a planned maintenance set-up, probably the highest priority is given to those critical units, a breakdown of which leads to immediate losses. Then, there may be units which would possibly lead to losses as a result of breakdown after a certain lapse of time. These units would have second priority. Finally, there may be numerous units of third priority which do not fall into the two other categories. The new method would give an additional means of classification. It stands to reason that a unit subject to great wear should get a higher priority than another one subject to little wear. In addition, the value of the unit has also a bearing upon priorities. A very ex-

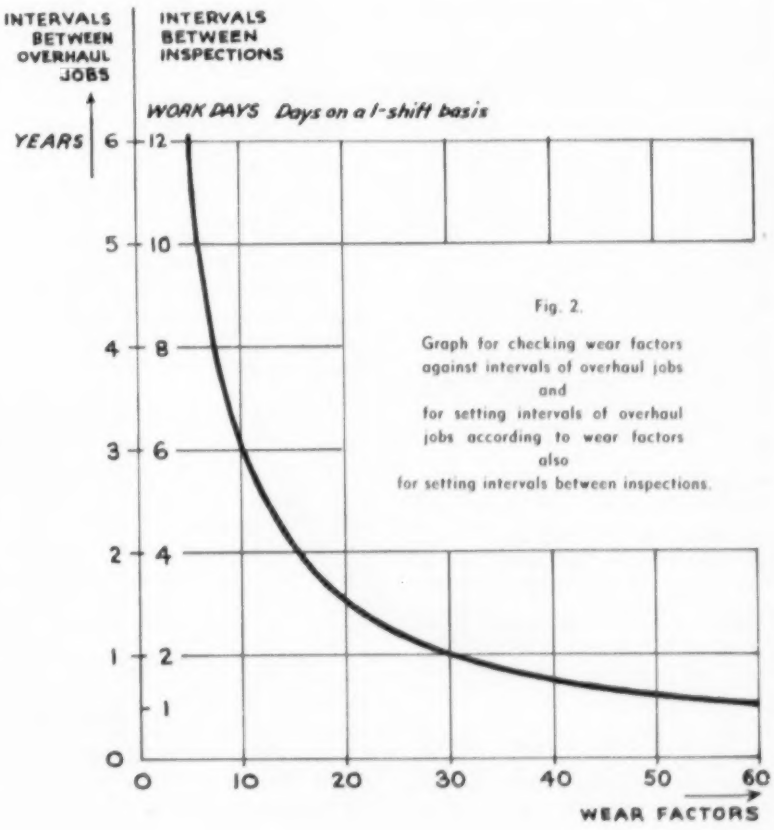


Fig. 2.
Graph for checking wear factors against intervals of overhaul jobs and for setting intervals of overhaul jobs according to wear factors also for setting intervals between inspections.

pensive unit deserves a higher priority than a cheap one. These factors are expressed by means of Wear Factors and Values, and their combination by limits in one figure each. Depending upon the method of issuing work instructions, it may prove useful to utilize these data as a guidance to foremen.

Control figures for a well balanced replacement program

If a unit is termed obsolete at the time its maintenance costs go permanently over limit, the situation can be analyzed with the following control figures. First, gain a measure of obsoleteness by expressing the total of obsolete units in percent of all units. This is

maintenance costs is close to the budget;

$$\frac{\$\ 9{,}500}{\$61{,}500} \times 100 = 15.5\%$$

The extra expense for maintaining obsolete units would be

$$300 \times \$16.85 = \$5{,}055 \text{ which is}$$

$$\frac{\$\ 5{,}055}{\$61{,}500} \times 100 = 8.2\% \text{ of the budget.}$$

To obtain a still better picture of the situation, it might be worth while to calculate these figures for specific groups of units or for all units of a department. The latter control figure might prove very valuable if an incentive system is used.

SMART ENTERPRISES CORP.

DEFERRED COSTS

Reference No. **1066** Equipment No. **5157**

Subject **broken shaft $225, labor $45**

Amount chargeable **$270** How many months? **10**

Month 1955	Amount Charged $	Balance $	Month 19	Amount Charged $	Balance $
Oct.	27	243			
Nov.	27	216			
etc.	etc.	etc.			

(lines continued)

Fig. 3. Principle of prorating.

basically a superficial approach since costs are of greater importance. For instance it may be desired to know how much more it costs to maintain the obsolete units relative to those which are not obsolete. To do this, it is advisable to earmark the history cards of all obsolete units and to add the total maintenance costs as per the last entry on these cards. The next step is to divide this total by the number of obsolete units. Then, do the same for the rest of the units. The results may look like this:

$$\frac{\text{Maintenance costs}}{\text{No. of obsolete units}} = \frac{\$\ 9{,}500}{300} = \$31.70$$

$$\frac{\text{Maintenance costs}}{\text{No. of all other units}} = \frac{\$52{,}000}{3{,}500} = \$14.85$$

$$\text{Difference} = \$16.85$$

In other words, maintenance of obsolete units is in this case 2.14 times more expensive than maintenance of the other units.

Next, it may be desired to know what portion of the budget is spent on maintenance of obsolete units. Assuming that the total of the preceding

Other questions which may now be easily answered are; (1) how many units are obsolete which are subject to more than average wear? (2) how many obsolete units are in service which cost more than an average unit? If such control figures are calculated at regular intervals, the problems connected with running a well balanced replacement program may be greatly simplified.

If desired, and providing the money is available, the new method can be used *to eliminate all obsolete* units in a systematic manner. If action is taken to obtain replacements only after a unit reached its limit, a number of obsolete units may be carried because of the unavoidable delay in obtaining replacements. This handicap may be eliminated by lowering limits to a certain extent. This, however, should not be done without a careful study of the development of maintenance costs and delivery required for the units in question. Otherwise, there is the risk of numerous premature replacements.

The control figures mentioned may also be used to adjust the budget from time to time.

Control figures for adjusting the budget

If a maintenance program has to take care of an increasing number of obsolete units while all other conditions remain about equal, it may not be able to live within the budget and vice versa. Here, there may be a very valuable opportunity to bolster opinions with measurable facts.

Explanation of a discrepancy

There may be a question in why the total monthly limits, on *Table No. 2* (page 46), of $6213 is larger than double the monthly budget — $5000 (2x$2500). It is natural to assume that they should be equal since one of the basic assumptions was that ". . . the limit should be reached, for example, when the maintenance costs of a unit reach double the average." However, these two figures will normally be different. They would be identical if all Wear Ratios would be unity, but if they differ from unity, it would be a coincidence if the total monthly limits and double the budget were identical, e.g., if Unit No. 5 has a Wear Ratio of 0.77 and a limit of $812. This discrepancy has no practical importance, whether the difference between the two figures is positive or negative, since it cannot be expected that all units will reach their limits simultaneously.

Another point: the meaning of the two figures—the total limits and double the monthly budget—is entirely different. The limits do not tell what to spend but when to stop spending. In contrast, the budget tells implicitly what to spend.

Conclusion

The introduction of the new method in the gas industry should be relatively easy since there is usually plenty of data available on corrosion and other factors which are needed for the Table of Wear Points. Another great advantage is that when there are numerous units, such as meters and valves, working under identical operating conditions, there is a reduction in the task of setting Wear Factors to a minimum. Perhaps no other industry is so favorably situated in these respects. To explore the possibilities of the new method should be a fascinating task for any ambitious maintenance engineer. ■

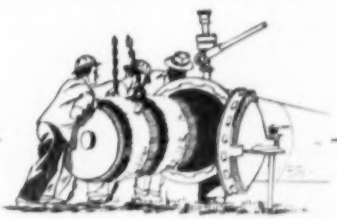
What does an investor look for in gas company stock?

By FREDERICK W. PAGE

"There are no well-defined 'financing patterns' in the gas industry," Mr. Page told his audience at the AGA financial forum in Santa Barbara, Calif., Oct. 14. "You not only have your production, transmission, and distribution segments, but in each of these divisions there is a wide variation in risk."

But there are certain well-defined concepts on which experienced investors base their judgments, he told them. These concepts are explained in this abridged version of his talk.

Mr. Page is praticularly qualified to talk on investor judgment, being a vice president of Tri-Continental Corp., Broad Street Investing Corp., National Investors Corp., and Whitehall Fund Inc., and a partner of J. & W. Seligman & Co. In clarifying his position as a buyer of stocks, Mr. Page explained that Tri-Continental is "the country's largest diversified closed-end investment company with net assets of slightly more than $260 million. In addition, we manage three open-end investment companies—Broad Street Investing, National Investors, and Whitehall Fund. These three companies have net assets of more than $130 million which gives us almost $400 million for investment, mainly in common stocks. All of our companies report quarterly, and in these reports give a complete list of portfolio holdings. In this respect we differ from pension funds, insurance companies, and other large investors. Our investment results are fully publicized and are judged in comparison with those of our competitors and market averages. Consequently, we have to make a year-to-year showing and cannot invest merely on a long term basis as can many other managers of large funds. We, therefore, are more sensitive to near-term developments and may sell a stock at any time if, in our opinion, it becomes overpriced in relation to its near term outlook."



● **Today, the big attraction that draws capital to a common stock offering is the possibility of appreciation. This means higher earnings and dividends and a higher price-earnings ratio—and of the two, the latter is often more important.**

There are four ways in which it may be attained.

WHEN buying common stocks, we are looking for appreciation. Some buyers may emphasize income, and some may emphasize stability, but all want some capital appreciation. In this respect I believe there has been a major change in the investor's approach to common stocks in the past 15 years. Back in the days before high tax rates, you could compete successfully for the investor's dollar by offering a safe, satisfactory income. With present high tax rates you no longer can compete on this basis with municipal bonds. They give greater safety, and to give the same net yield after taxes, your stocks would have to yield 7 to 10%. Also the difference in tax rates on long-term capital gains as compared to rates on ordinary income makes capital appreciation more desirable to the investor. Consequently, I believe you can compete much more successfully for the investor's dollar if you offer him a stock that can appreciate rather than one which is a second cousin to a preferred stock.

What will appeal to an investor looking for appreciation? Obviously a higher market value can be obtained on your stock only through higher earnings and dividends or through a higher price-earnings ratio. Of these two factors, the latter is often more important. As an example of this, railroad stocks currently sell at only 7 or 8 times earnings, whereas chemical stocks sell at 30 times earnings. It is often easier to obtain a 50% increase in your price-earnings ratio than it is to obtain a 50% increase in earnings. If you can obtain higher earnings and an expanded price-earnings ratio, your stock is obviously going to appreciate. Not only will this give you lower cost money on your common stock, but it will be reflected in your overall credit standing, and you will obtain better prices on your bond and preferred stock offerings.

Increased earnings

Increases in earnings are mainly dependent on economic conditions and

management. But, your financing policy can also be important. For the regulated portion of your industry there are only four ways in which you can improve your per share earnings: (1) a better overall return on invested capital (2) reinvestment of earnings (3) a lower cost of prior capital, and (4) an increase in the capital pyramid. The first two are more a function of regulation, management, and economic conditions, so I will skip over them at this point but will comment on the reinventment of earnings a little later.

Cost of prior capital

As to the other two ways in which per share earnings may be increased, you do not have much control over the cost of your prior capital. The cost of capital is determined mainly by money market conditions. However, there are a few do's and don'ts in connection with a financing policy. *Do* keep flexible and *don't* get into a corner where there is only one way out. Keep your capital structure in such condition that you are in position to issue any type of security and not forced to offer one specific security when the market for that security is in poor condition. Keep flexible in your thinking about financing. I have seen officers of companies plan their financing 'way ahead and then stick to those plans even though market conditions change greatly, and this can occur in a very short period of time. The money market is in a constant state of flux.

I have also seen companies plan a certain pattern of financing and then operate within that pattern come hell or high water. One of these patterns might be as follows: first, issue common stock, then issue preferred, and finally issue bonds and keep rotating financing in this order. This pattern was a product of the 1920s and its objective was to get equity behind the bonds so that a better price would be obtained for them.

I don't believe this pattern any longer makes much sense. The spread between yields on AAA, AA, and A bonds has narrowed so greatly and tax rates have increased so materially that there is not much to be gained by an improved credit rating. On the other hand, common stock money is your high cost money, and if you can obtain higher per share earnings by doing your low cost financing first, I think this should be your objective. Of course, any such pattern should be geared to market conditions. If you have a good common stock market but a poor bond market, offer common and vice versa regardless of your predetermined pattern.

Another pattern that I have seen companies rigidly follow is to finance construction through bank loans until a certain amount has been reached at which time the loan is funded. This is fine during an improving bond market but there are times when this pattern should be abandoned. For example, it would have been better to anticipate requirements with a large bond issue in 1952 and again in 1954, and this could have been foreseen.

There are a few other do's and don'ts that I believe can lead to an improved cost of prior capital. *Do* give the institutional buyer all the information that he requires, and don't try to hold anything back from him. His confidence in obtaining information and knowing your setup makes a big difference in his attitude toward your securities. *Do* sit down with him periodically in private either in his offce or during a visit to your properties and don't hold aloof as if he were a necessary evil to be avoided at all costs. A private visit during which he can ask what he believes are confidential questions is much better from his point of view than an invitation to a large group meeting or luncheon. Do try to schedule your offerings when the financing schedule is relatively clear and don't put an offering on an already overcrowded calendar.

Capital pyramid

The final way of increasing per-share earnings is through your capital pyramid. Changes in your capital pyramid can have a very important effect on your per-share earnings. Since the end of World War II it seems to have become the fashion to reduce pyramids and to build up the equity position. Thus during the best bond market we have ever had or may ever see again, proportionately few bonds were sold. At the same time an inordinate amount of common stock was sold in what until recently was a subnormal common stock market. The resulting dilution of per share earnings is one of the main reasons why you have the reputation in financial circles of being a rapidly growing industry in physical units but unable to translate this increasing demand into growth in earnings.

I have consistently been opposed to this trend toward higher and higher equity ratios and refer to it as 1929 encephalitis. Whenever we consider buying a common stock, I am not too interested in what the equity ratio is but what is going to happen to it. If it is going to rise, I don't want to buy the stock, but if it is going to decline, I am very much interested.

Obviously there are limits to which the capital structure can be pyramided. Because of the different risks involved I cannot give you any overall formula that could apply generally. The greater the risk, the lower the pyramid should be. Many of the transmission companies have already reached what I consider the limit. I beleve that they should have at least a 20% common stock ratio and a 15% preferred stock ratio which leaves a 65% debt ratio.

On the other hand, many distribution companies, probably because manufactured gas operations are still fresh in their memories, have built up a stronger-than-necessary high-cost equity position. A common stock ratio of 30% and preferred stock ratio of 15% appears adequately strong for them. Under today's accounting standards such a structure is probably stronger than a comparable 1929 equity ratio of 50%. Combination electric and gas distributors seem adequately financed with 25% common and 20% preferred stock ratios. Companies with stronger ratios than those above mentioned have an opportunity to increase per share earnings by financing with bonds and letting their equity ratios slip.

Price-earnings ratios

As earlier stated, price-earnings ratios can be more important than the earnings level itself in establishing a value for a stock. For example, we own two stocks both earning $4 a share and paying a $2 dividend. Yet when our portfolio was priced on Sept. 15, one of those stocks was selling at 31 and the other at 64. Why should there be such a discrepancy in price-earnings ratios?

The more we study the market and what makes stocks sell where they do, the more we become convinced that a high price-earnings ratio is the product of investor confidence in the earnings level and growth in earnings. By growth in earnings I don't mean Mcf send out, gross revenues, or even net income. What I refer to is *per share* earnings.

Common Stock... Does management have the stockholders interest at heart?

Investor confidence in the earnings level is of major importance and the investor must not feel that earnings are vulnerable to a substantial decline in any year. It was this fear that gave distribution companies a low price-earnings ratio in the days of manufactured gas. Under present operations you are in position to gain this confidence. However, to further this confidence, there are certain things you can do. For example, I believe that you should normalize unusual tax deductions. Your interest - during - construction policy should be given considerable thought.

Many companies today are reporting earnings which are affected to the extent of more than 10% by this credit. They may charge 6% on an item of property and then when that property goes into service it may return only nominal earnings during its early life Maybe your interest - to - construction policy should not be geared to any specific rate of interest but rather to the return expected on the particular item of property during its first year of service.

I cannot emphasize strongly enough how much a growth trend in per share earnings means to your price-earnings ratio. A few years ago Florida Power & Light, due to investor concern over collapse of the tourist trade and fear of hurricane damage, sold at a relatively low price-earnings ratio. Since then it has demonstrated a strong per share growth trend and today its stock sells at one of the highest ratios in the industry. Another example is Atlantic City Electric which in 1948 was considered a small boardwalk company by most investors. Since then it has shown some increase in per share earnings in each year, and today it also sells at one of the highest price-earnings ratios in the industry.

The year-to-year gain in per share earnings does not have to be substantial, but it should be steady. As previously noted, the regulated portion of your industry has only a few ways in which it can increase its per share earnings. Assuming that you are not already realizing a full allowable rate of return, an improvement in the return on the capital investment is the most effective way of obtaining higher per-share earnings. I am not in favor of rate increases if they can be avoided, but if under good economic conditions and efficient operations your earnings are inadequate, your stockholders can rightfully expect you to apply for a rate increase.

The next most important way in which per-share earnings can be increased is by increasing the capital pyramid and holding dilution to a minimum. Obviously there are limits to the pyramiding of the capital structure but because of its importance to per-share earnings, the timing and amount of a common stock offering should be given considerable thought. It can be coordinated with your general level of earnings. If earnings during a given year are expected to show a substantial increase due either to a rate increase, cold weather, or a reduction in costs, that is a good time to issue common stock. But offer only enough so that it does not dilute the entire gain in earnings. In years of a prospective small gain in earnings, avoid the issuance of common stock if at all possible.

Along the same lines I strongly recommend against the offering of stock through rights. The only possible reason for such an offering is to please some of your stockholders. In order to please them, the rights have to have some value and in order to establish value on the rights you must price the stock below the market. This means you are going to have to issue more shares to get in the same number of dollars than if you priced the stock at the market. The resulting unnecessary dilution will not help your per-share earnings.

Over the long run the higher per-share earnings obtained by eliminating this unnecessary dilution will please your stockholders more than if they receive occasional rights. Also, a rights offering is expensive, it usually depresses the stock during the rights period, and most stockholders sell their rights on a depressed market. A rights offering either dilutes a stockholder or forces him to increase his investment in the company. He may already have all he wants invested in the company and if not, he can always add to his investment through the open market.

A third way of increasing per-share earnings is through retained earnings. I am often asked what proportion of earnings should be paid out in dividends. There is no specific percentage that fits all companies. One consideration is what the company can do with the retained earnings. If a regulated company will issue a proportionate amount of prior securities and can earn a full return on the total investment, the return on the reinvested earnings can be quite large. Under these conditions the company is justified in having a low payout. In this instance the proportionately large reinvestment of earnings at a high return can contribute importantly to an upward trend in earnings. On the other hand, if a company can obtain only about a 6% return on its reinvested earnings, it is not justified in retaining a large portion of its earnings. In this case the reinvestment can have only a minor effect on the trend of earnings.

Management

Although investor confidence and growth in per share earnings are major contributors to a high price-earnings ratio, I would rate management a close second in this respect. When we consider an investment we find out all we can about the management. Is the management approachable, will we be kept informed about important developments, will we get an honest answer to an honest question, and most important, is the management operating the company for the benefit of the stockholders? Since this is the primary function of management, it is generally assumed that management does have the stockholders' interest at heart.

Unfortunately there are too many officers whose main objective appears to be to maintain their high salaried positions and the prestige that goes with the office. At the meeting last year in Atlantic City I heard Dean Mitchell make an eloquent statement about management's primary duty being to the common stockholder. In my 23 years of following your industry, this was the first time that I had heard anyone get up in public and make such a statement. I was so impressed that when I returned to my office, I had an analysis made of his company. Liking what we saw and having been favorably im-*

*Northern Indiana Public Service Co., Hammond.

pressed by the management we bought 20,000 shares of his stock.

In contrast to this, I was recently discussing financing with an officer of a company that had a capital structure consisting of 60% debt and 40% common stock. I recommended the use of some preferred stock and pointed out that not only would this give him some fundable property additions but as long as permanent capital could thus be obtained at a cost considerably less than the allowable return, it would benefit the common stockholder. His answer was that management had considered preferred stock and had decided against it. Although it was realized the company could not be thrown into bankruptcy by a preferred stockholder, modern preferred stock provisions make it possible for the preferred stockholders to bring about a change in management in the event that a certain number of dividends were unpaid.

Here was a management that gave its primary concern to maintaining its position rather than to the interests of its stockholders. Frankly if it could not earn enough to pay 4½% dividends on a small issue of preferred stock, it deserved to be thrown out. Put yourself in the investor's position. Would you rather have your funds under Dean Mitchell's management or under this other company's management?

Summary

To summarize all that I have said, I would like to review with you the five-year record of two utilities operating in contiguous territory and subject to the regulation of the same commission. One company I will call Co. A. Its management is extremely stockholder-conscious. In fact, it owns substantial amounts of the company's stock. It has adopted a very strong financial relations program and periodically calls on the large holders of all its securities and keeps them fully informed.

It has made a special effort to maintain an upward trend in per-share earnings and in so doing has increased its capital pyramid in order to offset a deterioration in its rate of return. It has avoided unnecessary dilution where possible and has made only one common stock offering through rights. Common stock has been offered only in years when the prospective increase in earnings offset the dilution of the additional shares. The financing policy has been kept flexible so that the company has not been forced to finance in a weak market, and it has been successful in reducing the cost of its prior capital.

In contrast, Co. B has a below-average financial relations program. Management is not too accessible to security holders and gives the impression of being primarily interested in maintaining its own position. Earnings have shown no upward trend. The company has maintained a very strong common equity position and has made no apparent effort to hold dilution to a minimum. Many of its security offerings have been poorly timed from the point of view of market conditions.

Now let us examine the five-year record of these two companies. From 1949 to 1954, Co. A's plant account increased 98% as compared with a 53% increase for Co. B. This obviously required proportionately heavier financing for Co.

A. In spite of this, the number of shares of common stock outstanding has been increased only 23% by the sale of new shares, whereas Co. B has increased its outstanding shares 41% through the sale of additional shares. Co. A's common equity ratio declined slightly from 33.2% to 29.7%, whereas Co. B's ratio has been maintained at approximately 40%.

Both companies have suffered some decline in the return on total capital. Co. A's return was 6.4% in 1949 and 5.3% in 1954. Co. B's return declined from 5.8% to 5.5% in the same period. In spite of the larger decline in Co. A's return, its earnings-per share record has been excellent due to the slight increase in the pyramid and lower cost financing. Using an index with 1949 equalling 100, its per-share earnings have been as follows: 100, 106, 107, 117, 133, 143. In contrast, Co. B's record in the same period has been 100, 92, 101, 90, 89, 89. With earnings up 43%, Co. A has been able to increase its dividend by 40%, whereas Co. B has done well to maintain its dividend.

With this earnings comparison it is interesting to see what has happened to the price-earnings ratios. In 1949, Co. A's stock sold at 10.8 times earnings, and Co. B's stock at 10.3. By 1954, Co. A's ratio had expanded to 16 for a gain of 47.6%, and Co. B's ratio had expanded to 13.8 for a gain of 34%. With 43% higher earnings and a substantial expansion in its price-earnings ratio, Co. A's stock appreciated 111.5% during the five year period—a very creditable showing. Co. B's stock, on the other hand, has appreciated only 19.5%, which must be discouraging to investors in view of the boom in the general stock market.

With its common stock held in higher regard, Co. A's cost of prior capital has declined. Although both companies have the same credit rating on their bonds, Co. A had to pay slightly [illegible] money in 1949, but today the reverse is true. The overall result of lower cost prior capital and a slight increase in the pyramid has been that Co. A's total cost of capital has declined from 5.8% in 1949 to 4.8% in 1954. Co. B's cost of capital, due almost entirely to an improvement in the price-earnings ratio in line with the higher stock market has declined only 0.4% from 5.3% to 4.9% in this five-year period.

I am sure that if you can compile a record approaching that of Co. A, you will have no trouble attracting capital and you will be performing the primary function of private ownership. On the other hand, if your record is similar to that of Co. B, I wonder how long you will be able to attract capital on a reasonable basis in our dynamic economy.

This leads to the final point I would like to make, and that has to do with the cost of money theory for rate making purposes. Of all the theories that have been promulgated during recent years, I believe this is the most dangerous. If broadly adopted and given great weight in establishing an allowable rate of return, nothing of what I have said makes much sense. There is no incentive to reduce the cost of your prior capital or to have your stock sell at a higher price-earnings ratio. In fact, it would be impossible for your stock to sell at a high price-earnings ratio because investors would no longer be interested in your stocks except at bargain prices. Today we will not invest in states where we believe this threat is real. Over the long run this theory could only result in a higher cost of money and a deterioration in service to the customer. ■

Holder heating is in focus as cold weather hits New England

By **HERMANN LAUDANI, Production Superintendent**
Mystic Valley Gas Co., Malden, Mass.

HERMAN LAUDANI

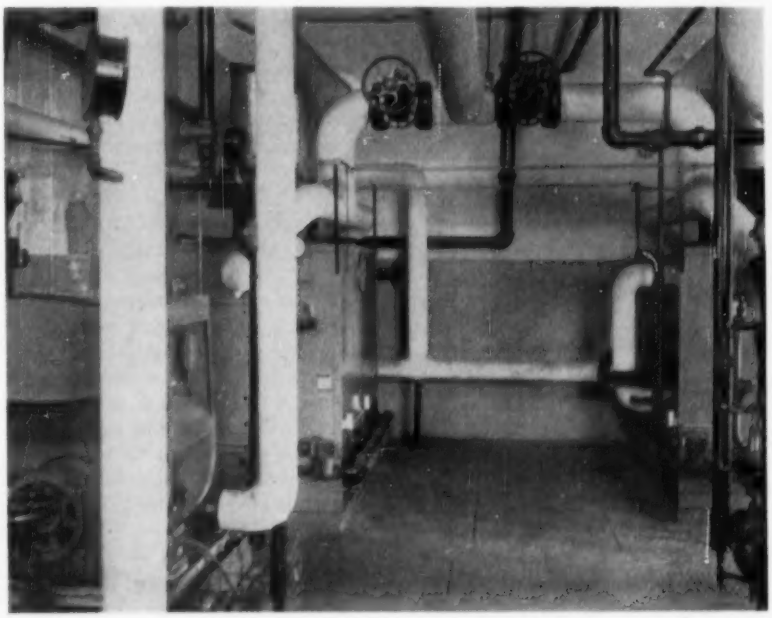
Got ice in your wet seal holder? Even if you haven't, it's time to start checking over the holder heating system in earnest, and working up some plans to avoid trouble next year. Check the way Mystic Valley Gas Co. avoids freeze-up problems with its holders.

HEATING of wet-seal holders in New England has always been an important phase of the gas business—and will continue to be so long as we must rely on holders to smooth out the top peaks. And while the trend may seem to be toward abandoning them among certain companies, moderniza tion in their operation—particularly in the field of automatic control of the heating cycle—has helped them to retain their usefulness in many places.

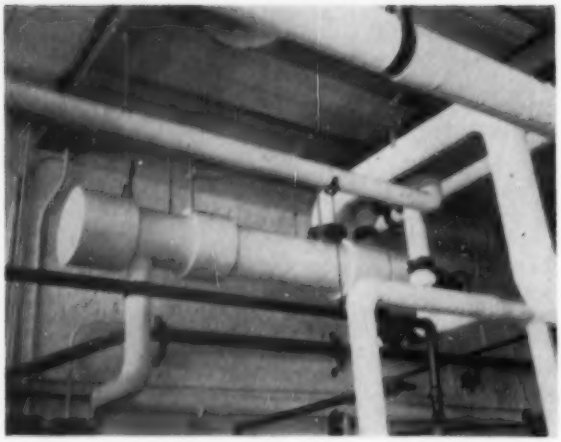
The real progress in holder heating in the last 20 years has been concentrated, more or less, at outlying holder stations, where active boiler plants and labor are not usually available. Automatic holder heating systems have been perfected to the point where one daily inspection for checking the equipment and changing of recording charts will suffice. An alarm system has been incorporated in the holder heater installation which will automatically alert, at the plant, or other remote control point where personnel are on duty, by means of audible and visual alarms whenever certain faults occur in the system.

With the consolidation of the Mystic Valley Gas Co. distribution systems several years ago, it was found necessary for efficient operation to consolidate the operation of the three district holder stations with full control from a central focal point located at the Malden gas plant. The consolidation provided for the installation of automatic holder heating systems, automatic holder filling, telemetering of holder heights, and equipment to telemeter gas pressures and gas flows to the control center at Malden. These installations eliminated the necessity of manual operation of holders, boilers, and distribution equipment in the outlying districts, and established a centralized control of gas storage and output for the entire gas distribution system.

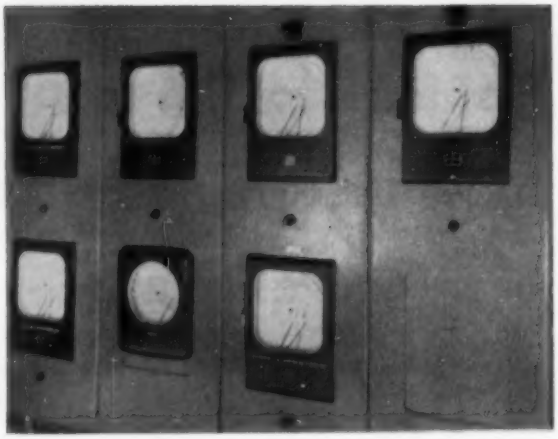
The installation at the Revere holder station, which supplies the 2-MMcf holder, is typical. It has three cast-iron, gas-fired, low-pressure steam boilers, each having an output steam rating of 1,150,000 Btu per hour. Each boiler has 24 individual gas burner cocks, permitting selection of minimum heat input as the heating season progresses. Although the piping arrangement permits any combination of the 3 boilers to be used for holder heating, only two boilers are normally used to supply heat to the holder water heat-exchanger and the third is valved off to provide heat for the various buildings.



Holder heating boilers and steam manifold to heat exchanger. Each boiler has 24 individual gas burner cocks, permitting selection of minimum heat input as the heating season progresses.



The holder water heat exchanger is directly connected to the boilers by a 6-in. steam supply line and a 3-in. return.



Receivers at Malden control center showing holder heights, gas flows, pressures, signal lights, and holder height remote control switches.

These boilers cannot be interchanged freely. First, because the holder heating boilers operate under a slight vacuum whereas the building heating boiler operates with a positive steam pressure of 5 to 10 psig. Second, the holder heating boilers have not been provided with automatic feedwater controls inasmuch as they operate in a closed system, whereas the condensate for the building heating return system is pumped back to the boiler. It is obvious then that it would be impractical to combine boiler operations because of the differences in operating pressure and return systems.

The heat exchanger, which is directly connected to the boilers by a 6-in. steam supply line and a 3-in. return, is 4 ft-6 in. long and 17.75 in. in diameter. It is of the straight-tube horizontal type, with removable tube bundle, two-pass construction capable of heating 100 gpm of holder water in the tubes from 38°F to 78°F, with steam at atmospheric pressure.

Each holder heating boiler has been provided with high-water limit controls located at the rear of the boiler. These are the probe types. Low-water limit contacts are on the front of each holder heating boiler in combination with the electrical, low-water fuel cut-off. Either extreme water-level condition operates an alarm at the control center in Malden by means of the telemetering system. However, water level extremes of the building heating boiler will not operate the control center alarm, although low-water protection has been provided to shut down this boiler.

Holder water is pumped by a 15-hp, 220-v, electric motor-driven, centrifugal pump rated at 110 gpm water against a head of 250 ft. The delivery pressure from the pump to the jets on the holder is about 100 psig. If the discharge pressure at the pump should fall off to 75 psig, due possibly to motor failure or plugging up of the pump impellors, a pressure switch located on the pump discharge would cut in and close the starting circuit on an auxiliary gasoline engine-driven pump. This pump, which is belt driven by a 20-hp gasoline engine, will deliver about 90 psig. and will run continuously until either the gasoline is exhausted (probably in five or six hours) or the power is restored, if that was the original cause of motor failure. Restoration of 100 psig would energize the pressure switch and stop the engine-driven pump. A repeating-type relay box, for starting, has been provided to insure against constant engine cranking and consequent battery failure. A trickle charger keeps the battery charged. If the engine fails to start after several cranking periods, the cranking will be discontinued and a light will show on the relay box. Manual reset will be needed to continue cranking. Upon failure of the motor-driven pump or operation of the gasoline engine pump, an alarm will sound at the Malden control center. This alarm will continue until the electric motor pump is back in service.

A test operation of the auxiliary engine pump is performed daily during the heating season and weekly during the summer months to keep the equipment in good operating condition.

The piping installation at Revere provided a new 3-in. suction line to the pumps from the holder tank and a 3-in. supply line from the pumps and heat exchanger to the existing 4-in. header above the platform of the holder. The four-life 2-MMcf holder has three nozzles in each cup and four nozzles in the tank.

The normal operation is to provide approximately 10-15° rise in holder water temperature by turning on the required number of burners. The water temperature can be increased a maximum of 40°F with outdoor air temperature at 0°F, if all burners are turned on in both boilers.

This teemperature gradient is ascertained by a two-pen tempertaure recorder showing the water temperature at the pump suction and at the discharge of the heat exchanger.

However, at the time of the operator's daily inspection, the quantity of heat supplied can be regulated to meet changes in the temperature of the return water or changes in weather conditions that have developed since his last inspection or that are anticipated before his next visit. An operator soon learns to know the number of burners required to maintain sufficient water temperatures during various weather conditions.

In conjunction with the telemetering system used to convey such vital information as pressures, gas flows, holder height, etc., from the various remote points of the distribution system to the Malden control center, a system of alarms has been incorporated in the telemetering system to alert the con-

trol center of any abnormal condition existing at the outlying holder stations.

Together with the water temperature recorder as a guide for efficient operation, fuel and power consumption for the holder heating system can be determined by installing gas and electric meters on the equipment. Cost comparisons can be made in this way as the heating season progresses, if records are kept of : (1) gas and power consumed (2) number of burners turned on in each boiler, and (3) corresponding tempertaure rise in the holder water.

A more conventional system is of course possible at the Malden plant itself. Here steam is available almost constantly during the winter season, so it is used for heating the circulating water for both the four-lift, 2-MMcf holder and the three-lift, 1 MMcf holder. These holders are located side by side, approximately 300 ft from the boiler plant. The method of heating and circulating water through the cups and tank of the holder is rather conventional and has been in use a great many years.

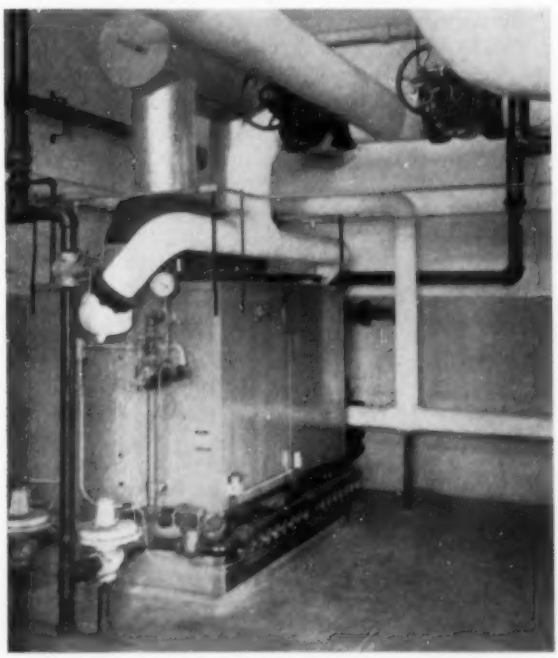
A heat exchanger, 8 ft long and 20 in. in diameter and containing 209 sq ft of heating surface, is used for heating the circulating water. The tubes of the heater through which the circulating water passes were originally of steel. Because tubes had to be renewed frequently, due to leakage or corrosion, they were replaced about 20 years ago with tubes of monel metal. No further troubles have been experienced since. Exhaust steam in sufficient supply is utilized as the heating medium. There are two reciprocating duplex steam pumps, each with a capacity of 300 gpm against a head of 350 ft. Both pumps have been equipped with Darcova cup pistons on the water end to minimize slippage. The suction for the pump is taken from the tank of the 1 MMcf holder about 2½ ft below the water surface. Some companies prefer to locate the suction pipe near the tank bottom to improve water circulation in the tank. A small hole in the suction pipe, just below the surface, will break the vacuum and prevent syphoning all the water from the tank in the event of a line break.

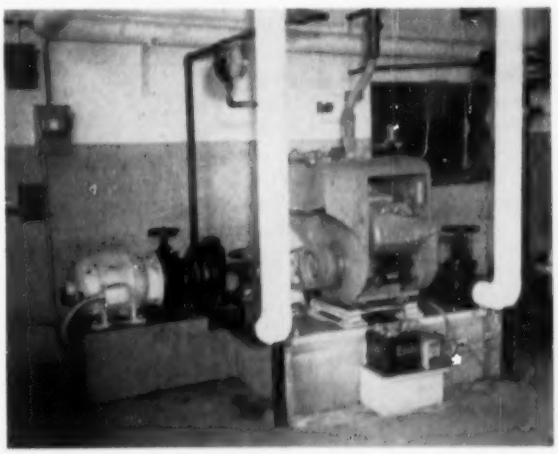
The present arrangement of taking the suction for the pump from the 1 MMcf holder was made several years ago. Advantage was taken of the fact that the water tank of the 2 MMcf holder, allows excess water from the larger tank to overflow into the smaller holder through a pipe connecting the two water tanks. This eliminated two separate suctions and the problems associated with throttling valves to regulate the flow from each holder. This arrangement has worked out very satisfactorily.

The discharge from the pump and heat exchanger goes into a common header which branches off to each holder, at the holder site. The branch to the 2 MMcf holder supplies five nozzles in the tank and two nozzles in each of the three cups, whereas the branch for the 1 MMcf holder supplies four nozzles in the tank and two in each cup. The nozzles are located several inches below the water surface for best circulation of water in the cup or tank.

It has been the practice at Malden to start up the circulating water pump about Nov. 15 or as soon as continuous freezing weather might occur. This will transfer the warmer water from the tank to the cups. The heat exchanger is placed in operation when the outside air temperature falls to 20°F, which occurs about the first part of December. Our experience has shown that a water temperature differential of 40°F, or a discharge temperature of 75°F from the heater, will maintain the cups and tank free from ice except in cases of extreme cold weather of long duration. The circulating system is usually taken out of service about March 15 and not later than April 1. ■

This article is adapted from a talk presented at the NEGA operating division meeting in Hartford, Conn. on Oct. 25, 1955.





Left — One of the holder-heating boilers showing gas burner cocks and automatic controls.

Above — Electric motor-driven pump and auxiliary gasoline engine-driven pump.

Quick surface heat-up through tight control boosts die-block production

Fig. 1. Duradiant gas burners, of the nozzle mixing type, assure uniform, rapid heating of die blocks. Burners are lighted by inserting a torch through lighting ports in side-walls.

GAS utilization report

A NEW, gas-fired heating process, in use at the Heppenstall Co.'s Pittsburgh plant, is heating die blocks for hardening four to five times faster than conventional methods.

What was formerly a 20-to 30-hour operation, based on size of work load, is now performed in but 3 to 4 hours for loads up to 20 tons. The fast heating methods employ patterned radiant heat under completely automatic program control.

Die blocks processed at Heppenstall vary in thickness from 8 to 24 in. and a block 18-in. thick x 24-in. high x 66-in. long, weighing 8100 lb, is not considered large in size. Because of the relatively large sizes of sections involved and the inherent crack-sensitivity of die-block steels, a high degree of uniformity in heat application is required. With conventional heating methods, uniformity can be obtained only by extremely slow heating and long soaking cycles.

The Selas furnace, specially engineered for die-block heating, is designed to heat a 38,000 lb work load—equivalent to a single die block 16 in. thick x 36 in. high x 20 ft long—in only 3 to 4-hour cycles, according to the thickness of the work.

Completely prefabricated, the furnace when installed replaced one of 13 conventional gas-fired furnaces, of the same approximate size, in the company's line. Although it had not been employed to rated capacity, in the first five months of this year alone, 6½ million pounds of die blocks were heated in the Gradiation heating unit. The output—4 to 5 times greater than each of the adjoining conventional furnaces—was achieved with 20% less fuel consumption per pound of steel treated.

The furnace is so designed that each side wall is studded with large Duradiant gas burners *(Fig. 1)*, located so as to assure uniform, safe, fast heating of die blocks lying in front of them. The burners are of the nozzle mixing variety and designed to produce a flameless radiant effect. Much of their heat is thereby transmitted by direct radiation.

The original cycle in the Gradiation furnace was established as shown in *Fig. 2* in keeping with the metallurgical concept that no portion of the work should exceed its final temperature. As heat after heat of metallurgically-sound die blocks was produced, the Selas engi-

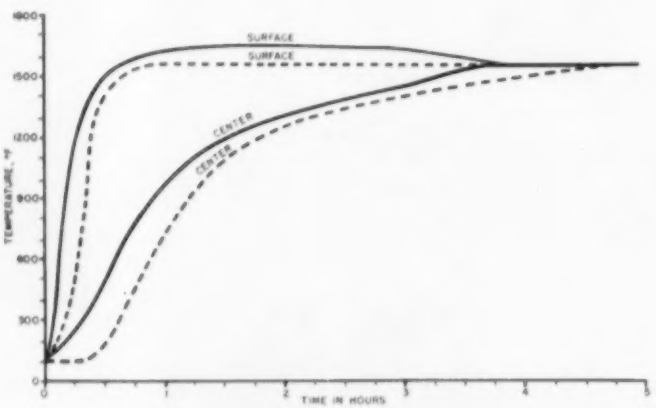


Fig. 2. Effect of two different gradiation heating cycles on heating rate of the 2500-lb work load. Dotted lines show center of work taking 4¾ hours to come to temperature. Solid line curves show time reduced by 1 hour when surface temperature is increased. Conventional heating cycles take 20 to 30 hours.

neers suggested taking fuller advantage of the heating potential.

Fig. 2 shows the result of increasing the thermal head to bring the work surface quickly to 1650° F, holding for only a short interval, then gradually reducing to 1550° F. The work center responds accordingly, reaching 1550° F in but 3¾ hours, as compared with the previous 20-hour cycles.

Automatic program control is obtained through the use of cams *(Fig. 3)*, which are cut so as to include the entire heating cycle. Cam shape is determined by the width of the load, and cams are cut for thicknesses from 8 to 24 in., in 2-in. intervals.

In operation, the cam functions as a remote setting to specify a desired furnace temperature at a particular location. A pneumatic impulse is sent to the work-surface temperature controller (lower left) and positions the index. The instrument responds by accurately proportioning the amount of fuel required to meet the work load pattern, whether increasing, decreasing or unchanging.

In the event the work-surface temperature controller fails to function for any reason, an instrument which records furnace temperature at the roof takes over as a safety device.

Fig. 4 is the flow meter chart showing gas consumption for heat 174, a 23,832 lb load, consisting of 15 die blocks. To show the consumption data more clearly, the chart was operated on an 8-hour rather than a 24-hour basis. Total gas consumed for the entire program was 25,550 cu ft, with a peak load of 30,000 cu ft per hour.

In spite of the momentary high peak load, the overall fuel consumption is low in relation to the adjoining conventional furnaces. In terms of cubic feet of gas per pound of work treated, the Selas furnace consumes only 80% of the fuel requirements of the other 12 units. This is a monthly average figure, and covers all operations, including heat-up.

The ability of the furnace to meet heating requirements in excess of 30 million Btu per hr assures a wide range of flexibility to meet substantial variations in work load, with the same precise response in program control cycling.

The automatic program control has reduced operating costs in several ways:

(1) Overall plant efficiency is improved because a close production schedule can be maintained. Manpower and crane quenching facilities are thereby utilized most effectively.

(2) Less skilled and experienced personnel can adequately handle the heating operation.

(3) Minimum attention is required. Only about 20 minutes of an operator's time is needed over the entire cycle operation. ■

Fig. 3. Proper control cam is inserted in position on control panel. In operation, the cam functions as a remote setting to specify a desired furnace temperature at a particular time.

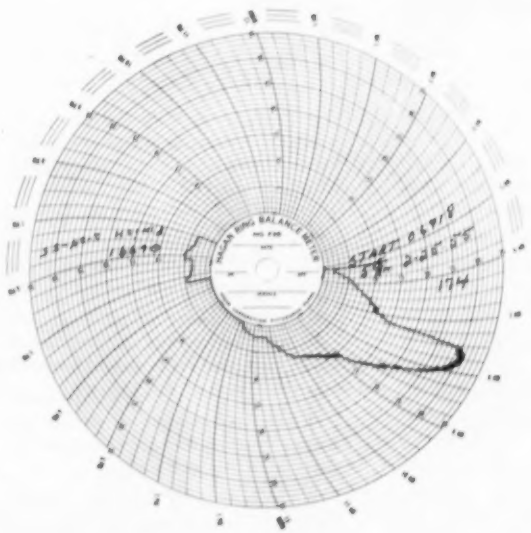


Fig. 4. Flow meter chart showing gas consumption for heat No. 174. Total gas consumption was 25,500 cu ft. Chart operated on 8-hour basis.

AGA public information program redoubles efforts

A long time in coming, the PAR public information organization is attacking ignorance and untruths on many battlefields. No. 1 job at present is to stem the tide of socialization, the blueprint for which is laid out in the pamphlet at left above. The news release (top right) is an example of the type of material being made available to member companies for local release. The other items are typical of "exchange" materials such as AGA circulates among gas utilities.

By JAC A. CUSHMAN, Assistant Director Public Information • American Gas Association

THE gas industry has harnessed an exciting new force in its battle for base loads. Its name—public information (or, if you will, public relations).

A major gap in the industry's communications with its employees, customers, stockholders and neighbors is rapidly being closed. Half a dozen basic areas of public ignorance about gas are under concentrated national and local attack through the AGA Public Information Program launched last January. Clippings and letters from member companies indicate increasing use of tools and materials supplied under this program.

At the same time, rising competition and public controversy promise that gas men will have to speak up even louder in '56 to be heard. Consequently, more and more company executives in the U. S. and Canada are turning to PAR Public Information as the most practical and most inexpensive way to win public understanding and support.

An informal audit by GAS reveals that Public Information scored the following accomplishments last year:

- Eighty-three utility and pipeline companies voluntarily subscribed to PAR Public Information More than a dozen additional companies have already indicated they will subscribed in '56
- Close coordination has been established with the information programs of other gas industry groups.
- Local economic information needs have been analyzed and company leaders alerted to the increasing growth of public ownership in the gas business.
- Local public relations activity was spurred through exchange of case histories, ideas and materials.
- Member companies were supplied with professionally-prepared materials to help them tell the story of modern gas service and appliances. 'Never before," one executive reported, "have we had such help on as many aspects of the business."
- At the same time, the modern gas story was kept before the public through articles for national magazines, newspapers, radio and TV.

Public Information, 1956 style, is the work of a 30-man task force of public relations executives from distribution and pipeline companies throughout the industry. This force is divided into General Planning and Projects Committees headed by Remick McDowell, The Peoples Gas Light and Coke Co., and James F. Purcell, Northern Indiana Public Service Co.

Members of this group have developed a highly flexible information program to help the industry meet its competitive challenges. Major planks of this program call for closer relations with regional gas groups and the devel-

opment of a united industrywide information program that tells the complete story of gas operations. Program materials will drive home the points that—

America needs a strong investor-owned gas industry;

Gas is a superior quality fuel;

Your gas company performs a vital community service;

Modern approved gas appliances are safe, dependable and economical.

PAR Public Information is now launching an all-out attack on six information targets:

(1) Develop greater awareness among employees, stockholders and customers of their vital stake in the American competitive system.

(2) Stimulate greater public appreciation of gas— the ideal fuel.

(3) Inform employees on gas industry fundamentals and stimulate public relations action.

(4) Create better understanding of the gas industry's economic and financial needs.

(5) Encourage investor interest in the gas industry.

(6) Acquaint teachers and students with the modern role of gas and gas appliances.

Several storm signals are flying. Recent PAR Public Information studies revealed that public ownership in the gas business has more than doubled in the past eight years and has tripled in the past ten. Federal housing amendments of 1955 provide for a $100 million revolving fund for establishment of municipal gas distribution and other municipal facilities—a major victory for public ownership. Another battle is shaping up in the Pacific Northwest where advocates of public ownership are developing non-profit cooperatives to organize, finance, construct and operate municipal gas distribution systems.

Early this year, AGA will begin to arm member companies with facts and materials they can use to help arrest the growing trend toward government ownership and subsidy of gas distribution systems. This project will be guided by a resolution of the AGA board of directors urging all member companies to support the premise that "government should refrain from competing with private enterprise and leave the development of public utilities and other business to the enterprise of individual investors."

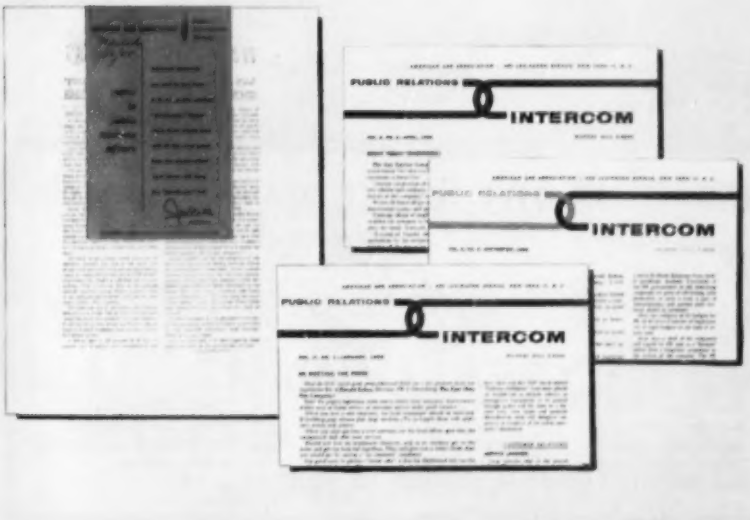
First step will be a monthly package of employee information feature articles, booklets and other materials for local use. Illustrated materials will tell the story of the gas industry's growth and plans for expansion; get across the tax story; explain the regulation picture; tell the rate story and point out the dangers of federal encroachment in gas as well as in other businesses. Companies will be urged to adapt these stories in terms of their own operations rather than from an overall industry viewpoint. Audiences to be reached with the competitive enterprise story are, in order of priority: employees, industry stockholders, customers, and the general public in

Replacement Market Richer, AGA Advises
Laboratory Tests Prove Gas Range Durability
GAS YEARBOOK HAS COMPLETE FUEL HISTORY

Good pictures mean good impressions. AGA photographic service Fotofile (top) supplied 1000 copies of dramatic gas industry pictures since it was started last summer.

Association's file of newspaper clippings shows at a glance the amount of acceptance the numerous news releases are getting from dailies throughout the U. S.

Exchange of information among gas companies is facilitated by the AGA's clearing house organization, which provides general circulation for worthwhile materials. At left is a reproduction of an editorial; at right are copies of "Intercom," the periodic bulletin of case histories of successful public relations ideas.



ALLTROL® CENTER make GAS RANGE

ONLY ALLTROL® BURNERS GIVE THRIFTY MEASURED HEAT

Instant full flame... brings foods to cooking temperature in shortest time.

"Click"... convenient Low Frying heat... provides perfect wide-spread low heat for "most used" frying operations.

"Click"...efficient Center Simmer...maintains boiling in any covered utensil.

"Click"...gentle "Keep-Warm" heat... keeps foods perfect for serving without further cooking.

SIMMER BURNERS SALES SIZZLE

Coast-to-coast the story's always the same—

These 6 Super-Selling Points move more gas ranges for more profit

Only gas ranges with Center Simmer Burners can give these 6 user-benefits. And when you demonstrate these advantages—you, too, will find your range sales shooting upward—fast!

The reason is simple: most people need to be *shown* that *modern* cooking means cooking with gas—on Center Simmer Burners. Demonstrate these 6 main advantages—to prove your gas range is indisputably best, on every count!

Write today for your free copy of "How to Sell More Gas Ranges."

6 benefits your customers buy

- **COOLEST COOKING**—The measured heat of Alltrol Center Simmer Burners keeps kitchens up to 9° cooler. Cooks the food—not the cook!
- **CLEANEST COOKING**—Clear blue flame can't blacken pans . . . and the "just right" heat eliminates messy boil-overs.
- **HANDY KEEP-WARM HEAT**—Tiny pre-set flames keep food and beverages perfect for serving without further cooking!
- **LOW FRYING HEAT**—Convenient "always the same" setting. Perfect for cooking fish, eggs and bacon. Eliminates guessing, peeking under the frying pan.
- **GREATER CONVENIENCE**—No "matching" of pans with burners—use any utensil on any burner! And you can set the right heat by sight or by sound.
- **THRIFTIER COOKING**—Save up to 39% on fuel costs alone! It's an important saving—for 80% of home cooking is done on the top burners.

ALLTROL CENTER SIMMER

HARPER-WYMAN COMPANY

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ORIGINATORS OF CENTER SIMMER BURNERS

Public Information exhibit. This modern exhibit outside the general session of the AGA-PCGA annual convention in Los Angeles presented a bird's-eye view of 12 PAR Public Information activities ranging from publicity to exchange of information.

communities served by member companies.

The competitive enterprise story will also be broadcast this year through a number of advertising mat series for use in local newspapers, magazines, employee publications and on company bulletin boards. The story of gas —the ideal fuel will also be presented in ad series of this type. Low-cost features of the mat service are particularly attractive to medium and smaller gas companies, but a number of larger companies are also using the mats successfully. Fifty-four gas utilities employed 1422 mats of the community relations ad series introduced last summer. A second series is being completed on the safety, dependability and performance benefits of the gas industry's appliance testing and approval program.

Increased exchange of company information materials and problems has a high priority on the AGA public information calendar. First step in this project will be to organize the country into regional information groups sponsored, wherever possible in cooperation with local gas associations. Each of these information groups will be highly informal. Officers may be limited to a chairman, secretary and small program committee, depending upon local needs.

Each group will act as the focal point for workshops on regional public relations problems and for exchange of information and ideas. Lessons learned during the past 18 months at workshop conferences in Seattle, Omaha and Boston will be incorporated into this long-range public relations workshop program, although the emphasis now will be more on local company communications than on the national level.

Other PAR Public Information activities started in January '55 will continue on the same scale or expand in '56. For example, gas companies will receive increased help in telling the story of gas—the ideal fuel to their various publics. Productions of stories on domestic gas utilization for local use will be expanded greatly. Press kits and publicity support will be prepared for national PAR promotional campaigns such as the Old Stove Round Up, Mrs. America campaign, New Freedom Gas Kitchen and Laundry Campaign and others.

Now ready for publication is a question-and-answer booklet containing authoritative information on the role of gas in the atomic era and a general purpose booklet on the gas industry's appliance testing and certification program.

Greater public appreciation of gas will also be stimulated through the correction of harmful publicity and through use of public safety kit for company information officers.

Exchange of information will be pushed through the periodic bulletin "Intercom," case histories and exchange of materials and ideas as well as through the long-range workshop program. One or more public relations how-to do-it booklets are also planned.

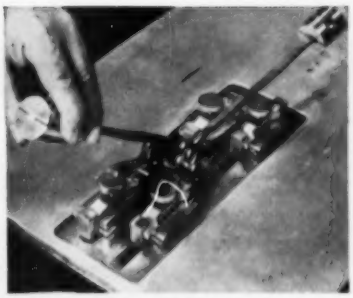
Economic and financial asects of the gas industry will be presented in a variety of ways. The current "This Is Your Industry" series of feature articles will dramatize the gas story for employees. "Pictograph" mats on economic and financial facts will be distributed to member companies as well as to more than 1700 newspapers. Also in the offing is a speakers' kit for national and regional gas industry speakers. Completing the list of major activities for '56 is the production of financial bulletins, sales and economic material for U. S. and Canadian investment

Forthcoming general purpose booklet on gas industry's appliance testing and approval program.

institutions, and the preparation of educational mataerial on the gas industry for encyclopedias, yearbooks and other widely used reference works.

PAR Public Information was financed last year by voluntary contributions from member companies of one cent a meter with a maximum subscription of $10,000 from any one company or system. Committee members are now backing a drive to nearly double the number of utility and pipeline companies supporting the program. These men and a growing number of company top executives are convinced, GAS learned, that the gas industry must do an even larger information job in '56 to capture its rightful share of the energy market. ■

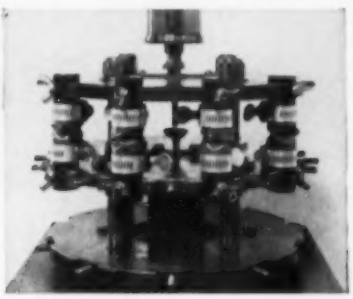
UNIFORMITY of weight and thickness of "Fairprene"* diaphragm material is assured by beta ray testing. Thickness of neoprene coatings is constantly controlled to meet the most exacting requirements.



SCRUB RESISTANCE of "Fairprene" diaphragm material is demonstrated by scrub test. Neoprene coating is securely bonded to fabric backing . . . is virtually unaffected by constant flexing and friction.

CONTROLLED SENSITIVITY is measured by "S-Fold Pliability Test." Immersion in oils and aromatic fuels followed by testing at extremes of temperature demonstrates the pliability of diaphragms made of Du Pont "Fairprene."

POROSITY of diaphragms of "Fairprene" to gases is tested by subjecting diaphragms to high air pressure under water. Absence of air bubbles indicates extreme pressures withstood by "Fairprene" coated fabrics.



FLEX RESISTANCE is shown by this flexibility test. Vibrator telescopes years of active service into hours, yet after this rugged treatment "Fairprene" diaphragm material shows no evidence of cracking.

Whatever you need in a diaphragm material ...you'll find in a Du Pont Fairprene® product

Manufacturers of gas meters are taking a close look at Du Pont "Fairprene" coated fabrics as a diaphragm material. And with good reason!

Diaphragms of "Fairprene" show exceptional resistance to the deteriorating effects of all types of gases—natural, manufactured, mixed gases and liquefied petroleum. Lightweight and flexible, these diaphragms withstand years of continuous service—even at extremes of temperature. "Fairprene" also shows exceptional tear strength, burst strength and resistance to loss of coating on exposure to the aromatic components of manufactured gases.

Almost any kind of diaphragm can be manufactured from "Fairprene"—along with hundreds of other industrial products. If you need a special gasket, seal, diaphragm or protective cloth in your plant—or to improve your product—it may pay you to investigate "Fairprene" coated fabrics. Du Pont engineers will gladly work with you in developing special grades of "Fairprene" to meet your own specifications. For further information about diaphragms of Du Pont "Fairprene" just clip and mail the coupon.

*"Fairprene" is Du Pont's trade-mark for coated fabrics, sheet stocks, and cements.

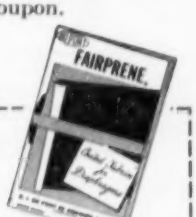
DU PONT INDUSTRIAL COATED FABRICS

E. I. du Pont de Nemours & Company (Inc.)
Fairfield, Conn.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

Mail coupon for further information . . .



E. I. du Pont de Nemours & Co. (Inc.)
Fabrics Division, G-62, Fairfield, Conn.

I am interested in "Fairprene" Industrial Products.

( ) Have a representative call.
( ) Send booklet "Coated Fabrics for Diaphragms."

Name _____ Title _____

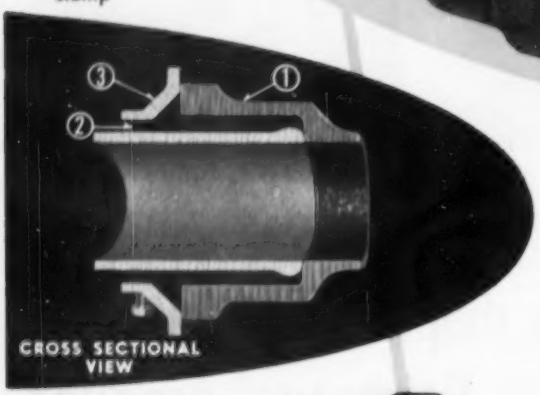
Firm _____

Address _____

City _____ State _____

Simplified Bell Joint Clamps

1. Bell joint
2. Perma-Seal Compound
3. Bell joint clamp



SEALED BY ADHESION

WITH PERMA-SEAL COMPOUND

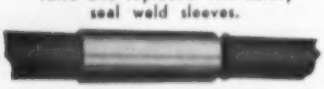
WITH THE FOLLOWING ADVANTAGES:

- Smaller street openings required because no excavating or cleaning necessary in back of the bell.
- The clamp does not require adjustment, or filling and facing of the bell.
- ***The clamp is engineered to fit all variable pipe wall thicknesses without adjustment and to fit all types of bell joints including sleeves, drip pots, valves and odd size pipes.*** Available sizes: 3" to 36" diameter.
- This clamp fits in confined areas because it requires no greater area than the existing bell for installation.
- ***This leak clamp becomes a seal by adhesion rather than by compression.***
- This clamp allows ground movement and vibration to take place without the danger of leaks after installation.
- Once installed the joint becomes trouble-free and permanent.

Write: for full information and prices about the Newest Method in Pipe Connections

New Perma-Seal and Safety Seal Weld sleeves available for steel to steel, steel to cast iron, split sleeves for repair of steel pipe, and completely insulated sleeves for corrosion control.

Typical installation in the removal of valve and replaced with safety seal weld sleeves.



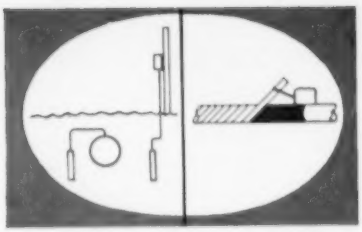
Steel to steel sleeve

Cast to cast sleeve

UNITED PIPE UTILITY SUPPLIERS, INC. BOX 777, BELOIT, WISCONSIN

Corrosion Prevention

DISTRIBUTION • TRANSMISSION



By GUY CORFIELD

Cathodic protection calls for co-existence

IT is generally realized that a cathodic protection system installed by one operator on his underground structures can "interfere" with and possibly damage adjacent underground structures of another operator unless carefully and cooperatively designed, and that the situation can become very complex where a number of operators are involved. It might be said that there arises in any such area a state of cathodic protection co-existence, which (to make a parallel with present-day international power politics) can become "uneasy" and could conceivably result in open warfare. It can become uneasy as operators strive for voltage advantage, and develop open warfare if any one operator, riding roughshod over his neighbors, builds installations without "notifications" that cause definite interference corrosion.

These possibilities are causing increasing concern to many corrosion engineers, as cathodic protection comes more and more into use and underground piping and other systems become increasingly more extensive and complex. It would seem obvious that, to cope with this situation, close cooperation between cathodic protection engineers is imperative. This is fortunately realized in many quarters, as evidenced by the committees that have been formed in various areas. The 1951 report of the Correlating Committee on Cathodic Protection listed 23 such organizations; there probably are and certainly should be many more.

One that has very recently been formed is the Central California Cathodic Protection Committee, covering the counties comprising and bordering on the San Joaquin valley. Its expressed purpose is: "To encourage the cooperative effort and the exchange of information relative to the prevention of corrosion of information relative to the prevention of corrosion of underground metallic structures in . . . counties." It is composed of active members who may include "any owner or operator of underground property within the area defined . . . who is concerned with corrosion inteference," and associate members who include "any person not qualified for active membership." Its policy and procedure are written as follows:

"As noted under purpose, the committee is to be, essentially, a clearing house for technical information pertaining to underground corrosion problems that are of mutual interest to the members . Such technical information should be considered as confidential, that is, not given distribution to the general public. The committee will function in accordance with the following general procedure:

(a) The committee will not undertake any testing program, nor engage in any investigations.

(b) Each member will conduct such tests and surveys upon its own property as it considers desirable, and shall be the sole judge of its own requirements. The arrangements for joint testing, mitigative measures, etc., shall be made by direct negotiations between the parties concerned.

(c) Cooperative principles set forth and agreed upon by the committee shall not be considered binding to any member but are for advisory purposes only.

(d) Each member, both active and associate, shall notify all active members of cathodic protection installation in accordance with the following suggested procedure:

(1) Area location.
Show the county and the nearest city or town that the installation is in or near.

(2) Rectifier location.
Show the approximate location to the nearest quarter-section giving the range, township and base meridian.

(3) Approximate location of anode.
Show the location with respect to the rectifier.

(4) Output.
Show the rated capacity and the normal operating d-c voltage and amperage for an impressed current installation and the number and type of anodes for a galvanic anode installation. In the case of galvanic anode installations only those consisting of five or more anode per 1000 ft of structure should be included.

(5) Brief description of structure protected.
Show what the protected structure consists of, giving the bearing and approximate extent of protection in the case of a pipeline.

(6) Status.
Show whether the installation is proposed, completed or has been removed.

(7) Date.
Indicate the estimated date the unit will be placed in operation, the date the unit was placed in operation, or the date of removal.

Dual purpose pipe coating

The description has recently appeared in Petroleum Engineer of an asphalt mastic pipe coating, interlaced with glass fibers to give it tensile strength, and containing weighting material to give a density between 130 and 240 lb per cu ft. It is designed to

provide both protection and weight for submarine lines.

It is stated that a continuous production line process has been designed for coating pipe and laying it from a barge whereby, after priming and extruding the mastic on the pipe, it is wrapped with fiberglass mesh, and then goes through a tight fitting segmented ring within which it is impacted by a circular group of air hammers, which compact the the coating to maximum density and firm bond to the pipe.

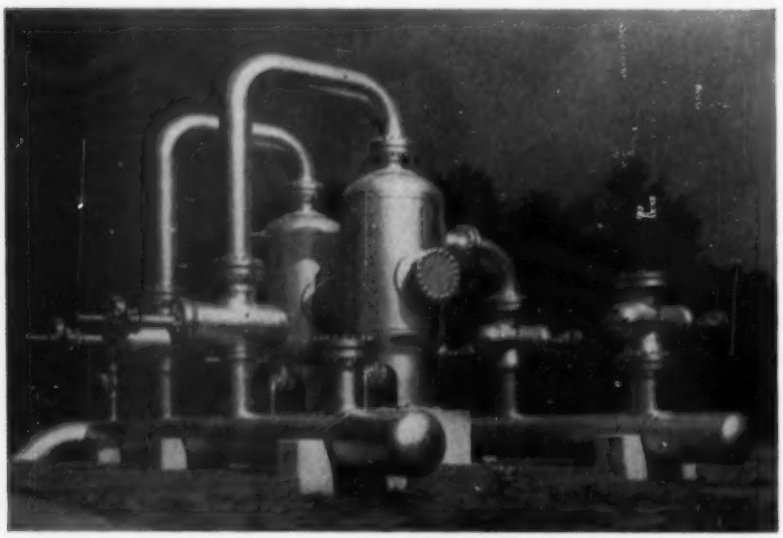
This coating and process has been developed by Southern Production Co., P. O. Box 670, Fort Worth, Texas.

NACE convention of interest to gas industry engineers

The National Association of Corrosion Engineers' 12th annual conference and 1956 corrosion show, to be held at the Hotel Statler in New York City on March 12-16, will have considerable interest for gas industry engineers.

The pipeline general symposium will include papers on Performance Tests on Pipeline Coatings, Cathodic Protection of Certain Submarine Pipelines, and an Outline of a Physical Theory of Underground Corrosion. There will also be a paper on Field Laboratory Testing of Wrappings for Buried Structures, one on Protective Criteria on a Pipe Section in a Uniform Environment, and one on Application of Cathodic Protection in Israel.

Papers on protective coatings will deal with sprayed metals plus plastic coatings, performance of galvanized coatings, refinery paint program to cut maintenance costs, and estimating for maintenance painting. The petroleum symposium will include a paper on concentration cell corrosion of well casing joints, one on cathodic protection of oil well casing, and one on cathodic protection of mobile off-short drilling platforms. There will also be a general corrosion round-table discussion on protective coatings and related subjects, at which questions and answers can be exchanged.



Manifolded to provide a capacity of 200 MM SCFD at 650 psig with a pressure drop of 1.5", these Aerotec units remove both dust and liquids from the gas.

AEROTEC GAS SCRUBBERS

designed to remove solids or liquids

On this 845 mile, 30" feeder line from Louisiana to West Virginia, five compressor stations present wide variations in contamination of gas being transported.

At some stations, the scrubbing problem presented is one of dry dust removal. All others, fluid carryover requires the removal of dust and liquid. Aerotec Scrubbers for these compressor stations were designed to handle the conditions encountered at each station. Resulting gas delivered to the 8000 horsepower compressors is dry and free from abrasive dusts.

Aerotec Gas Scrubbers are noted for their ability to deliver gas, free of fluid carryover. No liquids used in the scrubbing process makes this possible. Temporary overloads of up to 100% are easily handled without efficiency loss.

Contact our project engineers today. Ask for Thermix Data Sheets.

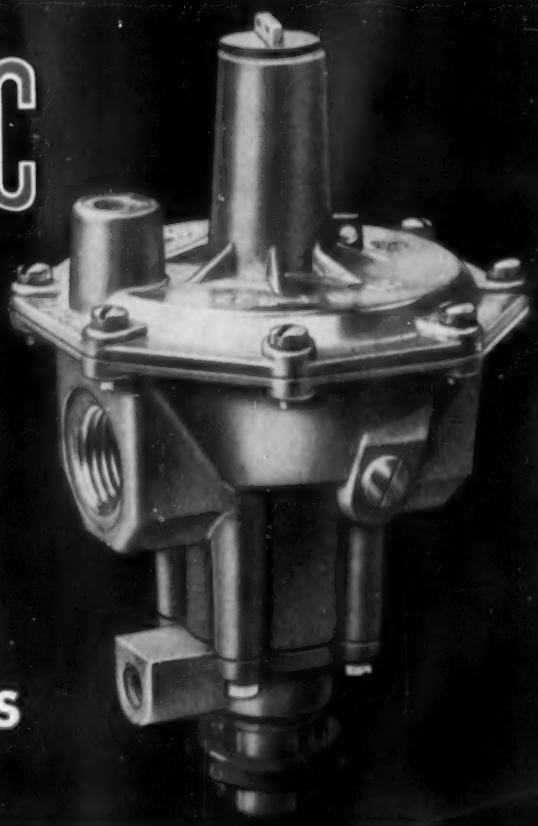
Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.
(Offices in all principal aircraft centers)
Canadian Affiliates: T. C. CHOWN, LTD, 1440 S. Catherine St. W., Montreal, Que.

THE AEROTEC CORPORATION
Aircraft Division Greenwich, Conn.

Off with the bowlers!

Has Manchester fallen prey to a craze for novelty at all costs? One might not think so; but look at what the North Western Gas Board has been up to. It has decided to abolish the bowler hat. This has been the traditional wear of our gas inspectors and other employees who deal with the public—a comforting thing to see riding on buses, bobbing along on a bicycle, or drifting up the garden path. But now the board means to clap on its employees' heads "a smart peaked cap with a special badge." What an odd notion. At this rate, Manchester will begin to look like Russia, where coal miners are got up lik field marshals, epaulets and all. A bowler hat we may be told, is an ambiguous sign of office—it could lead householders to mistake a gasman fo ra stockbroker, or a burglar for a gasman. But Harpurhey and Chorltoncum-Hardy are not Lombard Street; and although burglars may find a bowler hat a little easier to forge than a peaked cap with a special badge, they are bound to catch up in the end (besides, to most householders a peaked cap is a peaked cap, never mind the badges.—*The Manbcester (England) Guradian.*

THERMAC



Finest
GAS CONTROLS

What the name THERMAC on a gas control means to you . . .

Undivided attention to the specialty of producing gas controls has resulted in a number of basic and substantial design features around which our present products are built.

Concentration too, in manufacturing and production methods is also vitally important. In our own modern plant we do the entire job from Engineering and Research to Assembly and Final Testing — no one else is entrusted with this responsibility. Therefore, the controls you buy today are the result of 24 years of highly concentrated effort in research and in manufacturing techniques. Our volume production methods are your assurance of low cost.

Sound engineering, expert manufacturing, low cost and prompt delivery — that's what the name Thermac means to American Appliance Builders.

SEND FOR ILLUSTRATED CATALOG

24 YEARS' EXPERIENCE BUILDING GAS CONTROLS

THERMAC

Service is our job — on the spot engineering assistance and immediate delivery.

HM COMPANY 800 East 108th Street • Los Angeles 59, California

Never before-

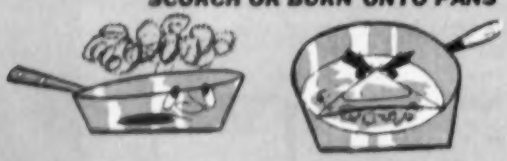
gas ranges with such magical automatic cooking freedom!

NEW Robertshaw® THERMAL EYE® **Automatic**

THINK OF IT!

NOW YOU CAN TELL YOUR CUSTOMERS FOODS WON'T OVER-COOK OR BOIL OVER

FOODS WON'T SMOKE, SCORCH OR BURN ONTO PANS

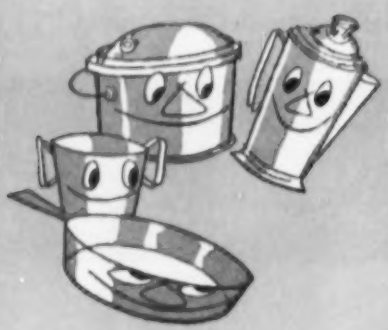


THINK OF IT!

NOW YOU CAN SHOW YOUR CUSTOMERS HEAT IN PAN CONTROLS FLAME

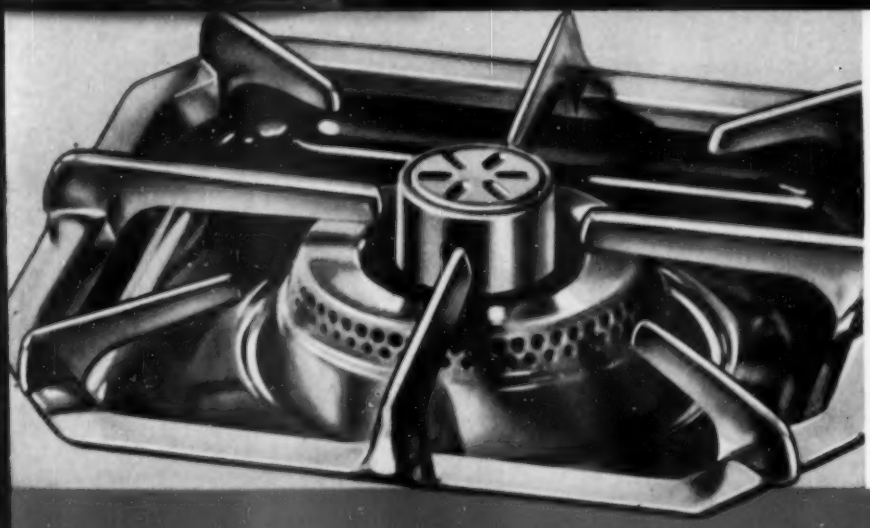
Sensing element in middle of burner is in contact with bottom of pan. It signals heat to thermostat that controls gas flow. Flame remains high until food reaches pre-selected cooking temperature, then gas input reduces. When food temperature drops below pre-selected setting, sensing element signals control and gas input increases to maintain desired temperature.

THINK OF IT! *EVERY COOKING UTENSIL IS AUTOMATIC*



Automatic top-burner controls give to gas ranges the same automatic service provided by automatic "plug-in" utensils—and it doesn't cost the customer more than a *single* good plug-in appliance.

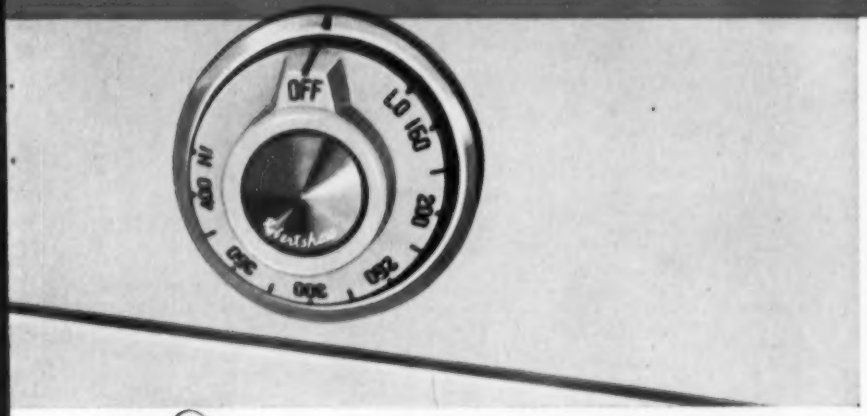
With an automatic convenience story like this, it's no wonder the Gas Industry calls this the *Golden Age Of Gas Range Selling!*



A NEW KIND OF AUTOMATIC COOKING FREEDOM!

A NEW KIND OF AUTOMATIC SALES STORY!

Top-Burner Control



To help YOU demonstrate and sell gas ranges equipped with automatic top-burner controls Robertshaw-Fulton offers you now free copies of a brand-new sales training manual, "More Income For Gas Range Salesmen." Everyone selling Gas ranges today – manufacturers, Gas Companies, LP-Gas distributors and retail salesmen – should have a copy of this free 20-page booklet.

Write today for *your free copies*, as many as you can use, to Advertising Manager, Robertshaw-Fulton Controls Co., Greensburg, Penna.

Robertshaw-Fulton
CONTROLS COMPANY

Robertshaw Thermostat Division, Youngwood, Pennsylvania

Robertshaw-Fulton Controls (Canada) Ltd., Toronto

13 half-hour TV Films
starring
DIONE LUCAS

BRAND NEW! Devoted exclusively to automatic top-burner cookery demonstrated by Dione Lucas, outstanding cooking authority and TV personality. Approved by American Gas Association. Already scheduled by many Gas Companies, large and small, for Spring TV promotions. Robertshaw-Fulton is paying for producing these new TV films. Gas Company sponsors will pay only for their local air time plus a small service charge to the film distributor.

GAS associations

Small discussion groups to feature NACE meeting

Leaders experienced in such fields as gas, oil, coatings, and cathodic protection will head nine small discussion groups on pipeline corrosion which will be one of the principal features of the forthcoming annual meeting of the National Association of Corrosion Engineers. The 12th annual conference and 1956 corrosion show will headquarter at the Statler hotel in New York City on March 12-16.

Four technical papers will be presented in the pipeline general symposium, while the pipeline and underground corrosion roundtable will be an informal meeting devoted to discussions.

Taking office on the last day of the conference will be the newly elected officers, headed by president-elect W. F. Fair Jr., of the Tar Products division of Koppers Co. Inc. Others are W. H. Stewart, Sun Pipe Line Co., vice president, and R. A. Brannon, Humble Pipe Line Co., treasurer.

Short course to stress corrosion and its control

Three days of lectures, demonstrations, and discussions on pipeline corrosion and its control will feature the 7th annual Corrosion Short Course for Pipeliners, scheduled for Feb. 15-17 at the Mayor hotel in Tulsa.

The program, sponsored by the Tulsa section of NACE, provides for a nontechnical presentation of the practical aspects of the causes of corrosion, measurements and instrumentation, pipe coatings, galvanic anodes, impressed currents, and miscellaneous corrosion control devices.

Lecture and discussion periods will be led by experienced corrosion engineers, including J. P. Barrett, Stanolind Oil; J. R. Cowles, consulting engineer; M. E. Parker, Cormit Engineering; F. M. Hieronymus, Barrett division; W. P. McCollister, Mississippi River Fuel; D. D. Griffith, Shell Pipe Line; J. L. Callahan, Service Pipe Line; O. W. Everett, Oklahoma Natural; W. L. Mabry, Colorado Interstate; and John E. Green, Shell Pipe Line.

Take a close look at the engineering and construction features of the Lancaster Groove Type Metal Rim Diaphragm and you'll see why it assures greater over-all accuracy and more years of service in the meter.

New—BETTER SEALING

Now Lancaster offers better sealing with the new Lancaster Buna-N-Cork Meter Gaskets. Here's the answer to that occasional gasket leakage. Send for a sample today and test it in your shop.

Lancaster METER PARTS CO.

POST OFFICE BOX 378 LANCASTER, OHIO

GAS association notes

Ed Parkes, director, vice president, and general manager of United Gas Corp., Shreveport, has been appointed by the AGA to serve as a director for a two-year term. He succeeds the late M. A. Abernathy, who had been elected a director at the association's 1955 annual convention.

Ways in which home service work promotes sound customer and community relations are covered in a new booklet, "Home Service Sells Through Public Relations," prepared by a subcommittee of the AGA home service committee.

M. J. Caparone, Robertshaw-Fulton Controls Co., Long Beach, Calif. has been elected president of a provisional southern California chapter of the Gas Appliances Engineers Society. Other officers are F. O. Suffron, Hammel Radiator Engineering Co., vice president; Arnold D. Carlin, Minneapolis-Honeywell Regulator Co., secretary; Clifford Mohr, Gaffers & Sattlers, treasurer. Directors: A. R. Duim, Mission Appliance Co.; Frank M. Day, Carrier Corp., and Arthur Theobald, Sequoia Manufacturing Co.

Full-Size 36" Model. Striking range with new, advanced luxury features available.

Space-Saving 30" Model. Boasts mammoth 24" oven, beautiful AstraGlo backguard.

20" Apartment Model. Now with high-style design, AstraGlo backguard.

Fabulous New Hardwick Built-Ins. Oven and counter-top units outstanding for popular price, ease of installation, beautiful appearance. White, Coppertone or Stainless finish.

now! a high style Hardwick to sell every prospect

Here are the glamorous new 1956 Hardwick Gas Ranges—a full line of high styled ranges to sell every prospect. The '56 Hardwick: styled by America's top designers, built to high Hardwick standards, and promoted to make your selling job easy. Hardwick ranges offer the world's finest cooking performance, and are the fastest-selling popular priced ranges on the market today. Display Hardwick models in all sizes . . . see how Hardwick's combination of beauty, top performance, and popular price help you sell more ranges.

ADVERTISED IN FULL COLOR IN

Ladies' Home Journal

•

McCall's

•

Better Homes & Gardens

•

House Beautiful

SEE HARDWICK FOR '56

HARDWICK STOVE COMPANY, CLEVELAND, TENN.

GAS people

Promotions

C. R. HETZLER has resigned as a member of the board of directors of Mountain Fuel Supply Co., Salt Lake City, and M. M. FIDLAR has been elected to succeed him. Mr. Hetzler retired as MCF vice president in charge of the producing and pipeline divisions in 1945. He has served as a member of the board since 1940.

E. J. FERGUSON has been promoted to the post of assistant general superintendent of distribution in the Pennsylvania and West Virginia divisions of Equitable Gas Co., Pittsburgh.

ANTHONY B. YOUNG, formerly head of the creative group in Peoples Gas Light & Coke Co.'s advertising department, has been promoted to assistant advertising manager.

Changes in the organization of the office of the vice president in charge of commercial operations at Public Service Electric & Gas Co., Newark, N. J., includes: SPENCER A. MOORE, general manager, sales; GORDON M. PETERSON, general manager, staff operations; BERTIL P. DAHLSTROM, general manager, rates and market research.

WAYNE R. SMITH SR., president of Continental Water Heater Co., retired on Jan. 1. He was one of the organizers of Continental, formed in 1927. In 1950, Continental was merged with National Steel Construction Co. Mr. Smith, an active PCGA and GAMA man, was a member of the board of National Steel. WAYNE R. SMITH JR. succeeds his father as general manager of Continental.

W. R. Smith
Continental

C. A. Schlegel
United Engineers

CARL A. SCHLEGEL has been named vice president in charge of United Engineers & Constructors' gas division, succeeding CHARLES W. HUNTER, who has retired after more than 50 years in the gas business. Succeeding Mr. Schlegel as gas sales manager is OSCAR A. GRAY, for years a gas sales engineer with the Philadelphia company.

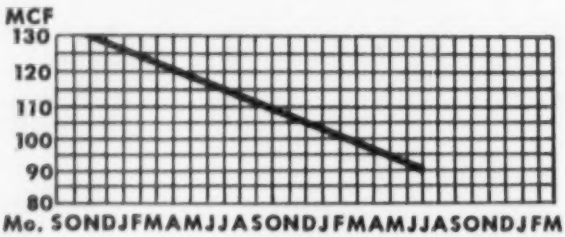
E. B. SUYDAM has been named president of Linde Air Products Co., New York, succeeding T. D. CARTLEDGE, who continues as a vice president of Union Carbide & Carbon Corp. WILLIAM M. HAILE has been appointed a vice president of Linde Air.

G. ARNOLD JOHNSON, who has been assistant to the director of research and administrative controls since 1954, has been named an executive assistant to Dr. H. L. Purdy, executive vice president of British Columbia Electric Co.

Recent appointments at Servel Inc. include the following: JOHN H. WALL, for the past year vice president and general manager of the home appliance division, has been appointed executive vice president; HARRY BOWSER, formerly director of sales development, is now sales manager of the home appliance division, succeeding ROLAND D. PAYNE, who has resigned;

Case history #6

"un-accounted for"
DOWN 30%!



A large Southern distribution system had an "un-accounted for" of over 132 MCF.

With SOUTHERN CROSS FORESTERS service their "un-accounted for" has been reduced to 92 MCF, a reduction of over 30%!

This is another example of the wisdom and profit in turning leak location and repairs over to SCF.

We have a plan to fit your system—

Plan 1. **Vegetation survey** — for residential areas.
Plan 2. **Safety survey** — for congested areas.
Plan 3. **Combination survey** — for coverage of the entire distribution system.

Our service includes completely equipped repair crews as well as consultants. With SCF crews "un-accounted for" losses are reduced without costly build-up of personnel or equipment.

SOUTHERN CROSS FORESTERS
3677 Buford Highway Atlanta, Georgia
MElrose 4-4227

IMPACT

TO HELP YOU

SELL!

ROPER
Tem-Trol
CONTROLLED-HEAT TOP BURNER
Makes Any Utensil Automatic!
Think of it! Automatic cooking in any utensil, right on your range top ... with heat control like that of your oven. It's so easy! Just "tune" the dial to the heat you want. Then "Tem-Trol" holds it. Foods cook just right ... every time ... "Personalized" to your family's taste. Geo. D. Roper Corporation, Rockford, Ill.
Only "Tem-Trol" Gives You All 3
Wide-Range Heat Selector
Super-Speed Burner
"Keep-Warm" Burner
You get highly accurate temperature control ... quick-as-a-wink start-ing ... exclusive low-heat settings.
WIDEST CHOICE OF controlled TEMPERATURES
High Heats For Frying or Other Super-Speed Jobs
Low, Low Heats for Delicate Foods
... Cocoa without boil-over
... Custard without a double boiler
WRITE YOU FREE FOLDER ON SEE YOUR ROPER RETAILER
ROPER
AMERICA'S FINEST GAS RANGE
Fashion Is Fame
FAMED FOR FASHION
Ask, Too, About ROPER "orANGEable" Built-in Gas Cooking Units and ROPER "DRY-AIRE" Gas Clothes Dryers

Powerful Roper consumer advertising is pre-selling for you in Better Homes and Gardens, McCall's, Better Living, Good Housekeeping, Town Journal, Farm Journal, and other leading magazines.

ROPER ADVERTISING HAMMERS HOME YOUR SALES MESSAGE

Potent consumer ads, like this, spearhead Roper's hard-hitting spring campaign. Tie in now. Order radio "spots," store displays, newspaper ads, direct mail pieces, other timely helps. Follow Roper's lead, and watch your profits soar. Get full details today. Don't wait.

GEO. D. ROPER CORPORATION
ROCKFORD, ILLINOIS

I want to tie in with Roper's spring campaign. Rush me full details.

Firm Name _____

Your Name _____

Address _____

City _____ State _____

G256

ROPER'S PLANNED PROGRAM to help you sell "TEM-TROL"

Smash Broadside | Radio Spots | Direct Mail | Store Displays | Newspaper Tie-in Ads

GEO. D. ROPER CORPORATION • Rockford, Illinois

CUT COSTS

ON UNDERGROUND

PIPING JOBS

...with a GREENLEE PIPE PUSHER

Installing pipe underground is quick and simple this way. With a GREENLEE Hydraulic Pipe Pusher *one man* pushes pipe through the ground—under streets, railways, walks, lawns, floors. Saves time, cuts costs through elimination of extensive ditching as just a short trench accommodates the Pusher. No tearing up of pavement, lawns, floors . . . eliminates tunneling, back-filling, tamping, repaving. Cuts job time to a fraction. Pusher often pays for itself through timesavings on first job or two.

No. 700 GREENLEE PUSHER For 3/4 to 4-inch pipe. Six speeds—5,600 to 40,000 lbs. pushing pressure.

No. 705 GREENLEE PUSHER For pipe larger than 4-inch, concrete sewer pipe, large drainage ducts. Six speeds—25,000 to 150,000 lbs. pushing pressure.

POWER PUMP For both sizes of GREENLEE Pushers. Pushes pipe at rate of two feet per minute.

GREENLEE

Get facts on timesaving Greenlee tools now. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1942 Columbia Avenue, Rockford, Illinois, U.S.A.

people • *Continued*

and EDWARD J. CASSIDY has been named director of quality control for the division.

ALPHONSE H. AYMOND JR. has been elected vice president and general counsel of Consumers Power Co., Jackson, Mich. He has been a member of the company's legal staff since 1947 and has served as general counsel since September 1955.

ROGER F. STRAUSS, engineer-lawyer of the Ohio Fuel Gas Co. rate department, has been promoted to attorney in the legal department.

GERALD E. WILSON has been elected vice president of Pittsburgh Group companies of Columbia Gas System, succeeding the late Earl D. Clutter. Other organizations changes are: JAMES G. MC KEE, superintendent of the distribution department, succeeding Mr. Wilson; expansion of executive duties of Vice President DAN J. EGAN to include employee relations, purchasing, information, civil engineering, service and reproduction departments.

J. FRENCH ROBINSON, recently retired president of Consolidated Natural Gas Co., New York, and chairman of East Ohio Gas Co., Cleveland, has joined the staff of Republic Steel Corp., Cleveland, in an advisory capacity.

ALBERT G. NEAL, vice president, general manager, and director of Fitchburg (Mass.) Gas & Electric Light Co., has been elected president, succeeding FRANK S. CLIFFORD, who is retiring as president after 53 years of service. Mr. Clifford will remain as a director.

Two promotions have been announced by Washington Natural Gas Co. ROBERT L. BEARDSLEY is now industrial sales manager and CARL A. LINDE will be assistant commercial sales manager.

J. D. ANDERSON has been promoted to general sales manager of the Jaeger Machine Co., Columbus, Ohio, succeeding J. H. YEARLING, who assumes the new position of director of market promotion.

Four members of the management staff of Delaware Power & Light Co. have been promoted. R. B. RICHARDSON, operating manager, is now assistant vice president in charge of ope-

ON CRAWLERS

TO DIG SERVICE DITCH

ON TIME!

WORKS EVERY DAY, RAIN OR SHINE No "fair weather" machine, the full crawler-mounted 403 works in deep mud . . . sticky gumbo . . . the most adverse ground conditions. The 403 has greater stability, yet treads lightly to protect lawns and sidewalks.

LESS DOWNTIME – Tractor-type crawlers on the 403 are strong, dependable, trouble-free . . . last longer with less maintenance.

MORE PRODUCTION – Compact design means greater maneuverability in close quarters. Cuts up to 5 feet deep in 8 to 12 inch widths; 4 feet deep in 14 and 16 inch widths. Easily transported from job to job in a hurry on low-cost tilt-bed trailer.

GET ALL THE FACTS about how you can dig more ditch per dollar with a Gar Wood-Buckeye 403. See your Gar Wood-Buckeye Distributor or write to Customer Service Department, Gar Wood Industries, Inc., Wayne, Michigan.

GAR WOOD INDUSTRIES, INC.

Wayne, Michigan • Findlay, Ohio

CONSTRUCTION MACHINERY
TRUCK EQUIPMENT

rations; FRED T. BEAR, manager of engineering, is assistant vice president in charge of engineering; they both will assist FRANK P. HYER, vice president in charge of operations, engineering, and construction. HAROLD W. CLIFT, assistant operating manager—gas, was named manager of gas operations.

F. H. Post

W. D. Miller

Robertshaw

WOODFORD D. MILLER, vice president and general manager of the Robertshaw Thermostat division, has been named executive vice president in charge of Robertshaw-Fulton Controls Co.'s eastern operations. FRANK H. POST, assistant vice president, succeeds Mr. Miller as vice president and general manager of the thermostat division. GEORGE MERTZ is now assistant to the general manager. The company has also announced the appointment of RICHARD D. HALL as sales representative. His office is located at the company's Grayson Controls division in Long Beach, Calif. MRS. SHIRLEY PEMBERTON has joined the staff of the company's home economics department.

Several promotions and appointments have been announced by General Controls Co., Glendale, Calif. MAURICE EASTIN is manager of sales for the Perfex division, headquartering in Skokie, Ill. R. C. SERVAT is manager of the Houston branch of General controls. BYRON B. SPINNEY is regional representative for the New York office with headquarters in Long Island City. JOHN F. DICKSON has been appointed manager of the Chattanooga branch office and GEORGE A. WILLIAMS JR. will manage the Detroit factory branch.

Recent gas department promotions at Public Service Electric & Gas Co., Newark, N. J., includes: JOHN A. LANE from superintendent of distribution, Newark districts, to division staff engineer, Essex division; WILLIAM L. HEUSER from assistant superintendent of distribution, Newark, to district superintendent; FRANK MC QUADE from senior designer to chief

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Tamper Proof
and
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for Over 80 Years

STANDARD PACKAGING

for Easy Handling,
Space Saving Storage . . .
Another HAYS First

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HAYS

GAS SERVICE PRODUCTS

HAYS MANUFACTURING CO.
ERIE, PA.

ENCLOSED CLUTCH CAN'T STICK OR FREEZE Ever!

WINCHES

Put an advanced Gar Wood 7000 lb. winch on your utility truck and you'll put an end to clutch trouble. All moving clutch parts are *fully enclosed and running in oil* . . . can't stick, freeze or rust because weather and dirt can't get in!

You'll put an end to the hazard of sudden slippage, too. Gar Wood's self-energizing safety brake and time-tested back-draft clutch give your operator much safer control of the load.

And that's not all! Gar Wood winches feature stress-free, tempered aluminum alloy housings that are lightweight, rust-proof, built for longer life . . . built-in rope clamp for easier attaching and changing of rope, better spooling . . . self-contained ball-bearing mounted worm shaft for smoother operation . . . extra rugged base angles for an extra margin of safety.

Get all the facts about Gar Wood 7000 lb. winches, available as standard or low mount. Call your Gar Wood-St. Paul distributor or mail the coupon below.

GAR WOOD INDUSTRIES, INC.

Wayne, Michigan • Richmond, Calif.

MAIL FOR SPECIFICATIONS

Customer Service Department G-1
Gar Wood Industries, Inc., Wayne, Michigan

Please send me specifications on Gar Wood 7000 lb. winches.

Name _____

Title _____

Company _____

Address _____

people • *Continued*

draftsman, gas engineering department; and WILLIAM C. DIEDERLICH from plant superintendent, West End gas works, to division staff engineer, distribution department, Bergen division.

JOSEPH BOWES has been named chairman of the board of Oklahoma Natural Gas Co., Tulsa. Succeeding him as president is H. A. EDDINS, who has been executive vice president since July 1954. Mr. Bowes will continue to serve as the company's principal executive officer.

Columbia Gas System's board of directors has elected CECIL E. LOOMIS senior vice president, FRANCES H. CRISSMAN vice president and chief financial officer, and H. EDWIN OLSEN vice president and secretary. Mr. Olsen is also a director.

WILLIAM H. OTTO has been promoted to director of public relations and advertising for Laclede Gas Co., St. Louis. He succeeds ROBERT D. LEWIS, who is retiring. CHARLES B. COLLARD is now advertising manager.

R. G. Rincliffe
Philadelphia Elec.

C. R. Holloway
Portland Gas

R. G. RINCLIFFE has been elected chairman of the board and chief executive officer of Philadelphia (Pa.) Electric Co. He will continue as president. Concurrently, A. S. CORSON, vice president in charge of finance, was elected a member of the board.

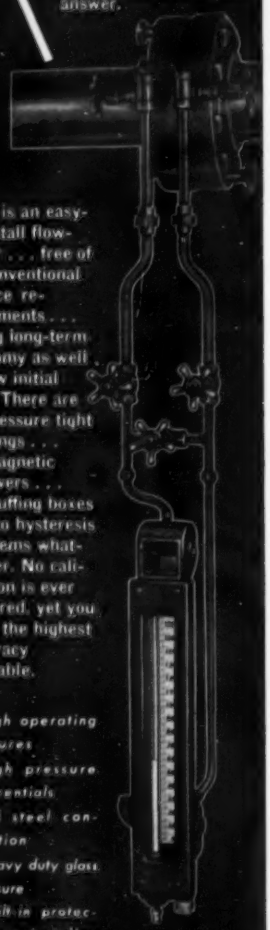
New faces

CHARLES R. HOLLOWAY JR. has joined Portland (Ore.) Gas & Coke Co. to fill the newly created post of vice president in charge of marketing. All of the company's sales activities are in his charge. He was formerly vice president and general manager of Liberty Fuel & Ice Co.

HOWARD R. MEEKER, chairman of the board of LeTourneau Westinghouse Co., has been elected a member of the board of directors of Citizens

UNMATCHED ACCURACY
in direct flow indication

Wherever you seek simplicity and high accuracy in flow measurement at lowest cost, the Meriam "H" Meter is the well-known answer.



Here is an easy-to-install flowmeter . . . free of all conventional service requirements . . . giving long-term economy as well as low initial cost. There are no pressure tight bearings . . . no magnetic followers . . . no stuffing boxes . . . no hysteresis problems whatsoever. No calibration is ever required, yet you have the highest accuracy available.

★ High operating pressures
★ High pressure differentials
★ All steel construction
★ Heavy duty glass enclosure
★ Built-in protection against line surges

Write for Bulletin 18A

Meriam Manometer Instrumentation
...for pressures, vacuums, flows, liquid levels.

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Gas & Coke Utility, Indianapolis. He replaces I. E. WOODARD, who has resigned.

ROY A. FRUEHAUF, president of Fruehauf Trailer Co., and GEORGE C. LEIB, vice chairman of Blythe & Co. Inc., have been elected directors of ACF Industries Inc., New York.

CHARLES F. KENNEDY, president of the Kennedy Valve Manufacturing Co., Elmira, N. Y., has been elected a member of the board of directors of the New York State Electric & Gas Corp., Ithaca. He succeeds FREDERIC H. HILL, who has retired.

W. F. WRIGHT JR. has joined the gas air conditioning division of Cobell Industries Inc., Fort Worth, as national sales manager.

LESTER L. CRAHAN has joined the Peerless Manufacturing Corp., Louisville, Ky., as West Coast representative, headquarters in Los Angeles.

Deaths

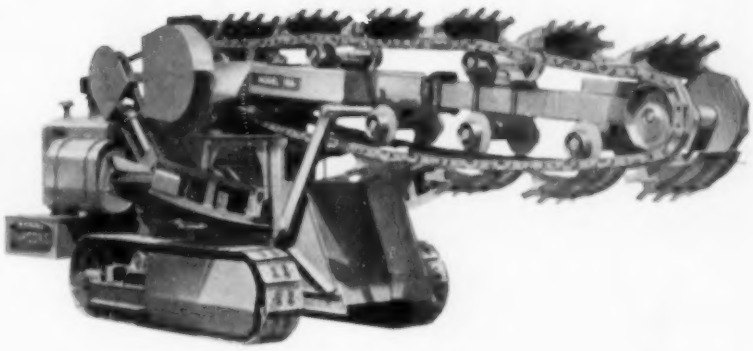
HORACE P. LIVERSIDGE, chairman of the board of Philadelphia Electric Co., died recently. He was 77. His work in the utility industry started in 1898 when he was employed as a wiring inspector by the Edison Electric Light Co., forerunner of Philadelphia Electric.

MARSHALL L. HOUGH, 56, president of Darling Valve & Manufacturing Co., Williamsport, Pa., died from a cerebral hemorrhage recently. He had been president and treasurer of Darling Valve for the past 20 years and a member of the Valve Manufacturers Association. He started in the drafting department of Darling Valve. In 1930 he was elected vice president and treasurer and in 1936 he became president.

FRANK EDWARD PAYNE, chairman of the board and co-founder of Crane Packing Co., died recently after a long illness. The 72-year-old industrialist was a nationally recognized authority in the products his company produces. He invented some of the most widely used packings in the marine field and general industrial and early foresaw the advantages of mechanical seals.

H. LLOYD NELSON, 52, director of market research, promotion and product scheduling for United States Pipe & Foundry Co., died recently in Birmingham.

working height only 7 FEET-4 inches



with NEW Parsons 155 Trenchliner®

Overall height (digging) 7'4"

Width (over crawlers) 5'4"

Trench widths from 16 to 26"

Maximum digging depth 8'0"

Production from 5.8" to 25 lineal feet per minute

Down-crowd boom (undercuts walks, curbs and gutters — makes vertical set-ins)

Self-sharpening, reversible "Tap-In" teeth

Power-shift spoil conveyor, reverse-direction belt (discharges to either side)

Dual-purpose friction clutch (drives bucket line, serves as automatic safety to protect against shock loads)

Full crawler mounting, with 12" flat shoes or 16" grouser type treads

Low ground bearing pressure (only 4.6 to 6.1 lbs. PSI overall length on crawlers)

Choice of engine (gas or diesel power available)

For work and travel in restricted operating areas, take a look at the low overhead clearance and narrow width of this new, small, ladder-type Trenchliner. It's compact, light in weight — yet brings you a big "plus" in digging widths, depths and speeds. Check its work capacity and heavy-duty features listed here — then ask your Parsons distributor to demonstrate what this utility-size 155 can do for you.

mail to: PARSONS Company, NEWTON, IOWA *(Koehring Subsidiary)*

Send us bulletin on the new 155 Trenchliner.

NAME_____ TITLE_____

ORGANIZATION_____ DIV_____

STREET_____

CITY_____ STATE_____ 2K155GAS

Gas Digest

A digest of what's new in products and trade literature compiled by the editors of GAS as a reader service.

New Products and Trade Literature

For more data on any of these items use the Readers' Service Cards on pages 81, 82

1. Mobile crane

Quick-Way Truck Shovel Co. has announced a new Quick-Way line for 1956.

Among engineering features in the new models are power up and down boom; anti-friction bearings on all high-speed, continuous rotating shafts; all chain and sprocket drive; air-cooled clutch and brake drums; smooth, positive hydraulic system and clutch controls; and hinged, foldout panels all around.

Models included: 5-ton, ¼-yd; 8-ton, ⅜-yd; 10-ton, ½-yd; and a 12½-ton, heavy duty ½-yd.

Quick Way Truck Shovel Co.

■

2. Booster compressor

The latest Cooper-Bessemer gas pick-up compresser, known as the FMP and ranging in capacity from 100 to 300 hp, is expected to find widespread use in gas lift operations, field gathering systems, repressuring and booster service installations.

For maximum versatility, cylinders of the compressor can be mounted singly for single-stage compression, in tandem or as twin units for two or more stages, adapting the unit to a wide range of services. It can be skid-mounted to operate as a portable unit or can be mounted on a conventional concrete base.

Cooper-Bessemer Corp.

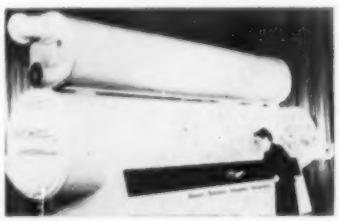
■

3. Tight-closing valve

Robertshaw-Fulton's new type "MA valve fills a need for a "tight-closing valve with good modulating characteristics." It is particularly applicable on medium and high-pressure pipelines for difficult deadend or complete shut-off service, the company said.

Although it was specially designed to avoid sticking and clogging, the valve does not develop a tendency to "chatter or rattle." Available in sizes from ¼-in. to 2-in. inclusive, the valve body is cast bronze. Poppet, seat insert, pilot poppet, and pilot seat are fabricated from stainless steel; the valve stem is of monel.

Robertshaw-Fulton Control Co.



4. Refrigerating machines

Carrier Corp. has introduced a new line of large capacity automatic "push-button" absorption refrigerating machines, which produce chilled water from steam, for use in air conditioning and process cooling systems. They range in sizes from 100 to 700 tons.

The absorption machines can be controlled by a time clock, thermostat, or pushbutton. It will adjust automatically from full capacity down to zero load, and back to full load again, with little loss in efficiency.

Carrier Corp.

■

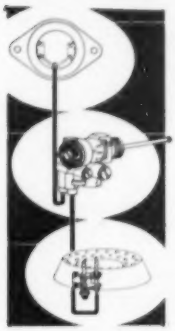
5. Zinc coating

A zinc coating that gives the cathodic protection of zinc to combat corrosion has been developed by the Wilbur & Williams Co. Zinc Shield, galvanizing by brush or spray, is especially applicable for bulk equipment whose size and location render hot dip or electroplating galvanizing impractical or impossible.

Zinc Shield can be used to restore worn or damaged galvanized surfaces, and make cracks or cuts impervious to rust creep.

Wilbur & Williams Co.

6. Water heater system



General Controls' new Dual Safe system for gas-fired water heaters embodies three control factors to provide automatic temperature control and 100% safety shutoff of all gas in the event of pilot failure or any other unsafe condition.

Featured are a high-temperature limit switch to prevent overheating; the G-2 water heater thermostat control, providing 100% gas shutoff; a 250-millivolt generator, which holds the pilot safety valve open with power generated from heat of pilot flame. If the flame should fail, the heat-powered generator will be unable to provide the power required to keep the safety valve open.

General Controls Co.

■

7. Coating resin

Bisphenol A, an intermediate in the manufacture of epoxy resins, is now available in commercial quantities from Monsanto Chemical Co.

A big use for these resins is in the manufacture of surface coatings with outstanding durability, and moisture and alkali resistance. They also go into structural laminates and into high-strength adhesives, especially for metal-to-metal bonding.

Monsanto Chemical Co.

■

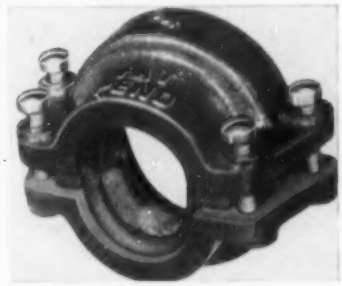
8. Built-in ranges

Stiglitz Corp.'s 1956 line of built-in gas ranges will feature ovens in both insert and stack-on types.

The new Stiglitz Infra-Aire gas oven features separate safety pilots for broil and bake. The broiler burner has a nickel and chrome wire grid that, upon contact with the gas flame, becomes infra-red, distributing heat evenly over the broiling area. The oven provides completely automatic baking and comes equipped with clock, signal timer, and automatic temperatoure control.

Stiglitz Corp.

■



9. Pipe sealer

The new Bel connector, introduced by Holoal Manufacturing Corp., is a cast-iron fitting that seals pipe leaks quickly, safely, and without cutting off flow in the systems.

The connector is designed to enclose the leak within captive neoprene gaskets when four screws are tightened around the pipe. The sealing gaskets thus form a gas-tight chamber, which equalizes pressure inside the pipe and out.

Two types of Bel connectors are available: the Elbow Bel for repairing pipe to elbow or T joints, and the straight Bel for connecting and for leaks in a straight section.

Holoal Manufacturing Corp.

■

10. Plastic pipe

The Malarkey Plastic division of M & M Wood Working Co. is now making available plastic pipe and fittings for residential, industrial, civic and farm uses.

Pipe sizes will range from ½ to 6 in. in standard lengths, both rigid and flexible, with a complete line of fittings.

Malarkey Plastics Div.

■

11. Centrifugal pump

Electri-Cand is a new line of leakless general purpose centrifugal pumps designed to handle liquids where no leakage is permitted.

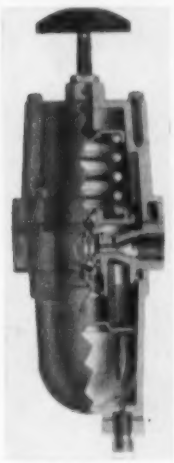
Produced by Allis-Chalmers Norwood Works, the pumps utilize the canned motor principle, in which the rotor of the driving induction motor rotates in the fluid being pumped and is connected directly to the pump impeller. This construction requires no packing or mechanical seals.

The pumps are available in a fractional horsepower line to include motors through 2 hp, and an integral horsepower line covering motors above 2 hp.

Allis-Chambers Manufacturing Co.

■

12. Air regulator

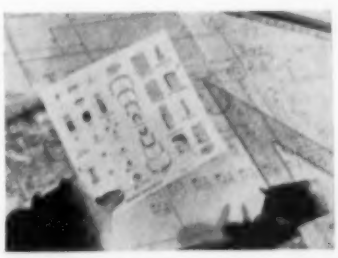


A new instrument air regulator (Type 73-26), introduced by Black, Sivalls & Bryson, is claimed to provide the close regulation demanded for instrument air supply in pneumatic instrumentation and in other installations requiring extreme sensitivity of pressure output in small volumes of air or other gas.

Higher air volumes, improved corrosion resistance, and a 40-micron phenolic impregnated cellulose filter are featured.

Black, Sivalls & Bryson Inc.

■

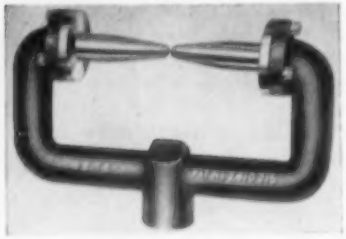


13. Drafting aid

Available from Panellit Inc. is a new drafting aid, designed to reduce the time required for graphic panel layouts. Called the Panelgraph layout template, it is a precision template with scaled outlines representing the most frequently used industrial instruments.

The representations are scaled accurately at 2 in. to the foot. Also provided are outlines for pumps, valves, and other graphic panel symbols as well as vessels. The template is fabricated from 20-gauge, frosted Lucite.

Panellit Inc.



14. Jet nozzles

Bete Fog Nozzle Inc. has introduced a new line of opposed jet impingement-type nozzles that is said to provide a more uniform drop size than is obtained with conventional nozzles.

The new Bete O. J. Series nozzles are available in four standard sizes ranging in flow rate from 3 to 30 gpm. Pipe connections are ⅛, ¼, 1, and 1½ in. Standard materials are bronze and aluminum.

Bete Fog Nozzle Inc.

■

15. Saddle tanks

Semi-oval saddle tanks have been added to Master Tank & Welding's line of Safer fuel tanks for trucks and tractors. The tanks are designed to give increased fuel capacity without increasing the amount of space required. They do not require special brackets for installation, but can be bolted directly to the truck frame.

Master Tank & Welding

■

16. 36-in. gas ranges

One-piece waterfall top for easier cleaning and a large 20-in. oven plus storage space are featured in the 1956 Dixiemaster 300 series 36-in. gas ranges.

Four large Therma-Flex burners offer instant, pre-set selection of most cooking temperatures. The Dixie 300 will feature the giant cast aluminum griddle, which is removable to make a fifth extra burner.

Dixie Products Inc.

■

17. Flexible wrapper

A new flexible pipe insulation wrapper, Vycot, has been developed to cover heat insulation to protect it from deterioration by weathering, sunlight, moisture, and chemical action.

Vycot, introduced by the Industrial Laminates division of Fabric Distributing Co., is flexible, easily handled and installed, and conforms to all sizes and shapes and offers an excellent vapor barrier to all moisture, chemical fumes, and spills.

Industrial Laminates Div.

■

18. Scratch brush

A new stainless steel wire scratch brush for cleaning stainless weld beads is available from Air Reduction Pacific. According to the manufacturer, this brush will eliminate the possibility of oxidation of the stainless parent metal.

Air Reduction Pacific Co.

■

19. Pipe insulation

A new development in pipe insulation jacketing for protection of hot or cold insulated lines in the Pip-Jac.

Pip-Jac is preformed polyethylene. It resists damage from heavy blows and it will not take the contours of wrapping material on wrapped line. No painting is necessary.

Precut to 60-ft lengths, Pip-Jac is fitted around the insulation, after which is springs shut by itself. Longitudinal seams are fastened with staples, using an ordinary stapler. Fittings are protected by coating with special Pip-Jac adhesive tape, and the manufacturer claims that circumferential seams are sealed quickly with Pip-Jac adhesive tape.

Pip-Jac Co.

■

20. Dispatching system

RCA's communications products department has a simplified radio dispatching system designed to help motor transport carriers and other users of mobile radio to utilize and control rolling stock to maximum advantage.

Built around a systematized card rack, which enables dispatchers or management personnel to determine at a glance the immediate destination, schedule and load of each truck out, the system is applicable for utility, product maintenance, and other types of radio-controlled service fleets, as well as for motor transport vehicles.

The card rack is a compact, tiered unit, containing 54 clear plastic slots, which can be adapted for virtually any type of fleet operation, and for daily changes in procedures. It includes removable snap-on metal tabs for use in assigning and identifying slots for each of the company's route areas and individual trucks operating in each area.

Radio Corp. of America

■

21. Air conditioning unit

Hydrotherm's new Wet Package for year-round air conditioning requires a floor space of only 21 in. by 42 in.; it stands 36 in. high. The unit has been designed to be used in conjunction with forced convectors and baseboard systems.

The gas-fired boiler is complete in its cabinet with circulator and fill and relief valves. Heating capacities range from 45,000 Btu/hr to 150,000 Btu/hr. The water chiller, complete within the jacket, can be 2 or 3 tons.

Easy access is provided for service and installation at the rear of the unit. A three-way valve is provided for simple changeover from heating to cooling.

Hydrotherm Inc.

■

TRADE LITERATURE

22. Water heater folder

Ruud Manufacturing Co.'s new four-page folder describes advantages of direct gas-fired storage type automatic water heaters to furnish domestic hot water for multiple dwellings (Form 982). Ruud-Monel Sanimaster, which delivers two temperatures of hot water from a single tank, is described by diagrams and cartoons.

Ruud Manufacturing Co.

■

23. Glass fiber catalog

A complete, condensed explanation of its many glass fiber products and their applications is contained in a new catalog from L. O. F. Glass Fibers Co. Microlite and Super Fine blanket insulations, Microflex compressed board, quartz and glass Micro-Fibers are described and illustrated in Catalog No. WPD-11.

L.O.F. Glass Fibers Co.

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on New Products and Trade Literature

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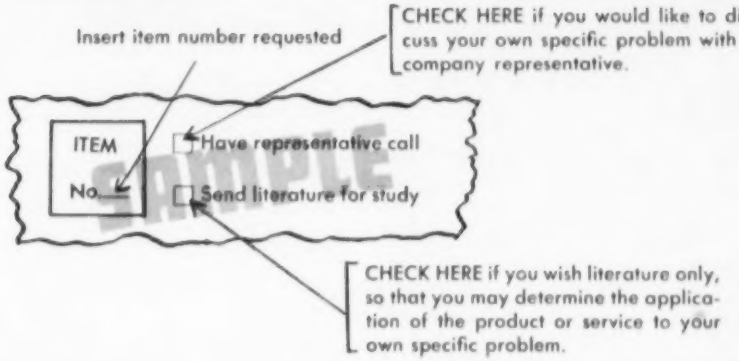
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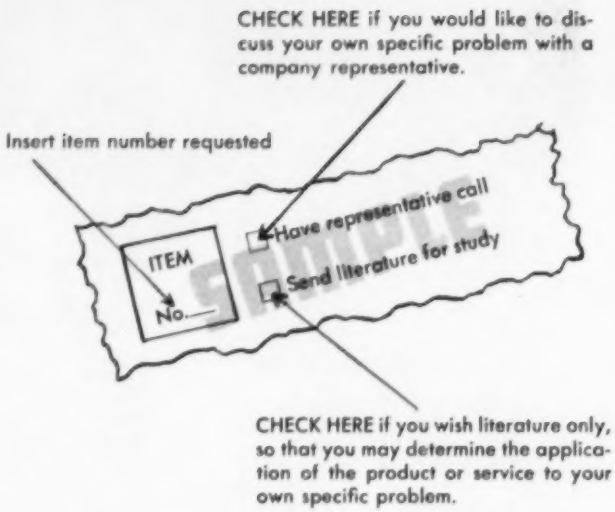
CHECK HERE if you would like to discuss your own specific problem with a company representative.
Insert item number requested
ITEM No.
Have representative call
Send literature for study
SAMPLE
CHECK HERE if you wish literature only, so that you may determine the application of the product or service to your own specific problem.

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24. Electronic aid report

Two vexing problems in transmission and distribution of natural gas—pipeline pulsation vibration and noise—are being solved by engineers aided by electronics, according to a report issued by Burgess-Manning. The report, illustrated with oscillograms, drawings, and photographs, reviews case histories of seven specific problems solved.

Burgess-Manning Co.

■

25. Respirator data

Respirators which have been designed for protection in atmospheres not immediately harmful to life, such as welding and cutting fumes, toxic dusts, paint spray vapors, and fumes from molten metals, are described in a two-color catalog from Mine Safety Appliances. In addition to the three new air line respirators, the bulletin also describes accessories for constant flow and demand-flow types as well as portable air line respirator equipment.

Mine Safety Appliances Co.

■

26. Technical bulletin

Recently published is a technical bulletin (V5010) on Automatic Switch Co.'s midget size 3-way solenoid valve. Valve pressure ratings and flow conditions are contained.

Automatic Switch Co.

■

27. Welding booklet

An eight-page bulletin (1343) from Lincoln Electric describes that company's Idealarc welding equipment. Detailed information is presented on the combination Idealarc with both AC and DC output.

Lincoln Electric Co.

■

28. Pump catalog

Standard end suction centrifugal stainless steel pumps for chemical sump, tank car unloading, underground tanks, and numerous applications where air or vapor handling capacity is required, are described in a new bulletin from Worthington Corp. The new bulletin on Worthite self-priming centrifugal chemical pumps offers data on maximum interchangeability and coverage, minimum spare parts requirements, and reduced maintenance cost. (Bulletin W-350-B13.)

Worthington Corp.

■

29. Process plants data

"Process Plants by Blaw-Knox," a new catalog just released, has been designed to provide information on the diversity and scope of work undertaken and completed in the process industries field. Design, engineering, construction, and initial operation of process industries plants are outlined in the 20-page publication.

Blaw-Knox Co.

■

30. Water vapor measurement

Gravometric, dewpoint and wet and dry bulb methods are discussed in a new bulletin on how to measure water vapor in air and other gases. The 12-page bulletin is issued by Pittsburgh Lectrodryer Corp.

Pittsburgh Lectrodryer Corp.

■

31. Pump bulletin

Ingersoll-Rand's vertically split, single-stage, and two-stage type process pumps are described in a new 20-page two-color bulletin. Design features, dimension tables, cross sectional and installation views, plus a two-page chart showing the extensive interchangeability of parts are contained in the bulletin (Form 7094-B).

Ingersoll-Rand

■

32. Fittings folder

A six-page folder from the Tubular Products division of Babcock & Wilcox (FB-500) furnishes in concise form the types and size ranges of various welding fittings and flanges. The folder should be of interest to engineers involved in refinery and power construction and maintenance and piping contractors.

Babcock & Wilcox Co.

■

33. Heater manual

A 24-page manual has been published by Delta Tank's Oil Field Equipment division covering the company's new line of 10- to 24-ft long indirect heaters, whose rated heating capacities range from 250,000 to 4 million Btu/hr. The heaters have been designed to prevent hydrate formation in both gas and gas-condensate streams of transmission or production systems.

Delta Tank Manufacturing Co.

■

34. Gauge brochure

Gauges for recording and telemetering gas pressure in distribution and transmission systems are described in a new bulletin (DMG629) from Bristol Co.

Bristol Co.

■

35. Compression fittings data

Highlighted in a new 12-page brochure from Dresser Manufacturing division is the use of the company's flexible compression fittings on steel piping and copper tubing. Illustrations of typical uses, taken from case histories and featured throughout the catalog, should be of special interest to equipment designers and piping engineers. Complete specifications are also given.

Dresser Manufacturing Div.

■

36. Instrument bulletin

A "pointer" bulletin has been issued by Illinois Testing Laboratories to present a brief description of the salient features of each instrument in the ITL's line. Also included is the number of the bulletin which gives complete engineering data on a particular instrument.

Illinois Testing Laboratories

■

37. Water tube boilers data

Superior Combustion Industries has described its packaged water tube boilers in its recently revised 12-page catalog (115-D). The new publication uses color and illustrations to amplify the descriptive text. Complete data and dimensions are included.

Superior Combustion Industries Inc.

■

38. Vaporizer booklet

Vaporizers (both packaged and field-erected units), electrically heated vaporizers, and forced circulation liquid heating and cooling units are described in a new bulletin from Union Iron Works. Bulletin DV presents the full line of Union processing heating equipment for use with Dowtherm A and E, ParaCymeme, Arclor No. 1248, and heat transfer oil.

Union Iron Works

GAS NEWS

Arkansas court orders refunds on gas rates

An order for lower gas bills and cash refunds for Arkansas domestic customers of the Arkansas Louisiana Gas Co. has been signed by Pulaski County Circuit Judge J. Mitchell Cockrill, who affirmed an Arkansas Public Service Commission order of Jan. 7, 1955, setting up rate schedules for commercial, industrial and domestic users.

ElectroData Corp. recently dedicated its new half-million-dollar plant in Pasadena, Calif. The modernistic, California-style structure is the first of two such facilities completed to manufacture high-speed electronic computers. The five-acre site permits triple expansion.

The company announced that, barring a hitch, the lower gas rate for domestic users could take effect by mid-February and the first of the refunds could be mailed early in April. There were indications the program might be tied up if any of the large industrial users involved in the suit should appeal to the State Supreme Court. Company President J. C. Hamilton of Shreveport, La., estimated that the refunds would total $1.2 million plus 6% interest, while the rate reduction to domestic users would amount to $800,000 a year.

Reynolds Metals Co., one of the first to protest the rate schedule, since withdrew its protest and signed a pact with Arkansas Louisiana to buy gas at above the rates fixed by the PSC.

The refunds to domestic users resulted from the fact that the company since last July 15 had been collecting rates higher than those approved by the PSC. The company did this under bond.

"The company's contention," Mr. Hamilton said, "has been that the rate relief granted in the PSC decision was less than the amount which could be considered adequate.

"Nevertheless, in view of the costly and drawn out nature of rate proceedings in the courts, and in view of the withdrawal from the case of one of the principal protestants, Arkansas Louisiana has determined that no further purpose would be served by the company's prosecution of an appeal to the courts."

Cold weather accounts for increased gas sales

Current cold weather and a greater number of new gas customers were responsible for an 11.4% increase in total sales of the gas utility and pipeline industry in November 1955 compared to November of the previous year.

Sales during the month aggregated

Regulation Secrets Revealed

The hand tricks the eye and inventive genius sires most mystic phenomena. But, all mirrors removed, the simple truth about STRAIGHT-THRU-FLOW is this: it provides a freer gas path with less friction, less turbulence, more capacity than any other regulator.

No magic wands needed for efficient, economical gas regulation, year-in, year-out. Just chant "STRAIGHT-THRU-FLOW" four times while facing Detroit and let Maxine's Genie do the rest.

MAXITROL COMPANY

12200 BEECH ROAD • DETROIT 39, MICH.
Originators Of "STRAIGHT-THRU-FLOW"

6009 million therms, according to the AGA's report.

Natural gas sales by utilities and pipelines to ultimate consumers in November amounted to 5730 million therms, up 12.0% over the 5115 million therms sold in November of last year. Total manufactured and mixed gas sales increased 0.2% from 278.2 million to 278.8 million therms. Sales of mixed gas were up 4.0% to a total of 247.2 million therms, while sales of manufactured gas declined 21.9% from 40.5 million to 31.6 million therms.

During the 12 months ending Nov. 30, 1955, total utility and pipeline sales of gas aggregated 65,774 million therms, equivalent to an increase of 8.5% over the 60,622 million therms consumed in the 12 months ending Nov. 30, 1954.

Natural gas sales totaled 62,342 million therms, an increase of 8.7%, while sales of manufactured and mixed gas increased from 3279 million therms during the 12 months ending Nov. 30, 1954, to a total of 3432 million therms in the current cumulative 12-month period.

Rockwell's Canadian subsidiary in production

Production of meter products in Canada was begun recently by Rockwell Manufacturing Co. of Canada Ltd. at its Guelph, Ontario, plant. The company has also opened a new sales office in Toronto.

Complete meter servicing facilities and warehouse space have also been added to the Guelph plant, according to Thomas Wall, recently named general manager. He said the Toronto office is the first opened by Rockwell's Canadian subsidiary for the sale of meter products.

No-charge TV series offered gas utilities

Gas utilities are being offered a series of 13 half-hour television shows—starring Dione Lucas—on a no-charge basis. According to Robertshaw-Fulton Controls Co., which is making available the filmed television package, gas utilities accepting the films will pay only for the local air time plus a small service charge.

The nation-wide show, sponsored last year by 84 gas utilities across the country, is aimed at encouraging consumer interest in automatic gas cookery and the use of gas as the modern home fuel. Particular emphasis will be placed on automatic top burner temperature controls, the Thermal Eye, now available on many new gas ranges.

C. S. Stackpole, managing director

WRIST-ACTION HYDROHOE SPEEDS TRENCHING Hydrohoe wrist-action dipper is hinged at lower end of dipper handle and rotates a distance of 65 degrees. Result is bigger loads, cleaner trenches, more biting force, less spillage. Available in 12, 18, and 24-in. widths. Hoe has same precision control, boom telescope, and smooth action as Hydrocrane. Quickly convertible to crane boom in the field.

EXTRA ATTACHMENTS Multiply Gas-Job Value of Hydrocrane-Hydrohoe

Extra attachments, designed particularly for gas jobs, make the all-hydraulic Bucyrus-Erie Crane-Hoe an even greater favorite among utilities. They not only speed specialized digging and repair jobs, but are equipped with quick-change fittings—attachments can be switched in a few minutes.

Your Bucyrus-Erie distributor will demonstrate the all-hydraulic Hydrohoe or Hydrocrane—show you how these custom-matched attachments can save time and money. Complete literature is yours for the asking. Write today. 75H55

BUCYRUS-ERIE COMPANY
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BUCYRUS ERIE

HYDROHOE UTILITIES DIPPER Tailor-made for gas users, this new 20-in. wide, wrist-action dipper is especially designed for digging holes of greater depth than length. Dipper rotates 95° from 45° behind handle to 50° ahead. Here is an invaluable attachment for digging manholes, valve pits, uncovering pipe leaks.

NEW ⅜-YD. CLAMSHELL BUCKET Long, sharp teeth quickly knife into tough clay and hardpan. Smooth clean bowls shed sticky dirt in a hurry. Bucket closes by two hydraulically operated rams. Use of twin rams instead of single center ram provides 42 per cent more force to lips at point of closing. Bucket cleaner optional.

of the American Gas Association, stated: "This exciting national TV program . . . provides a real opportunity to stimulate greater public acceptance of gas as a truly modern cooking fuel."

Urging all gas utilities to "give serious consideration" to the Robertshaw-Fulton film offer in local gas range sales and promotional campaigns, he said, "I sincerely believe that it (Dione Lucas Show) merits the support of all gas utility companies."

In assuming the production costs of the popular TV series, Charles M. Stainton, vice president and director of sales for Robertshaw-Fulton, said his company is providing the opportunity for local gas utilities to bring to their market area top-flight TV at little more than the cost of station time.

Dione Lucas serves warm plum tart to gas industry executives in television studio kitchen following her daily homemaker show. From left: Frank H. Post, Robertshaw-Fulton; C. S. Stackpole, AGA; and Harold Massey, GAMA.

A complete package of promotional materials in support of the homemaker show will be available to the gas companies. This includes point of sale material, newspaper advertising mats, brochures for range salesmen, and material on new top burner controls.

Arrangement of the half-hour show includes three spots of one minute each, in which sponsors can present their own commercials or other messages. Robertshaw-Fulton will also make available to sponsors a selection of commercials on top burner cooking controls and automatic gas water heating. These one-minute spots are to be prepared with the cooperation of the American Gas Association.

It is expected that 50% of the country's more than 27-million residential users of gas will be able to see the Dione Lucas Show when the new series is first shown on March 1, Mr. Stainton said. Many leading gas companies including Boston Consolidated Gas Co., Brooklyn Union Gas Co., Columbia Gas System and Philadelphia Gas Works division of United Gas Improvement Co. have already announced they will sponsor the new television series.

Mr. Stainton explained that Miss Lucas will present her entertaining cooking program on a specially constructed composite range, whose maker will be unidentifiable. In addition to preparing foods using the new automatic top burner control, Miss Lucas will offer food hints, menu-planning suggestions, table-setting short cuts and a new question-and-answer feature.

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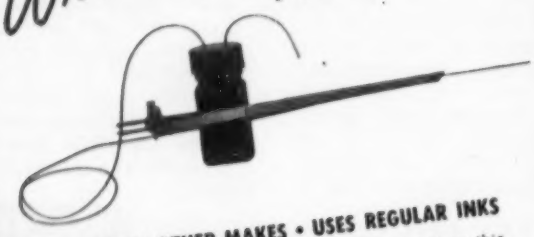
ARCCO CANNON NEVER-DRY PEN

Writes for Months



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SEND FOR BULLETIN No. 115

SoCal to establish new operating division

To keep pace with the rapid growth of the southeast section of Los Angeles county, Southern California Gas Co. is forming a new division with headquarters in Downey.

Activation of the new administrative organization is planned for early in 1957, following construction of a division office building and operating base.

The new division will start its existence with approximately 110,000 customers, according to F. M. Banks, president and general manager. Large-scale residential development as well as industrial and commercial expansion have marked the area since 1940, with most of the growth coming in the last five years. This growth has placed a heavy service load on the southern division, which company officials feel can be relieved through establishment of the new operating unit.

Washington firms organize to coordinate activities

R. C. Hayes

Eight of the state's gas companies have formed the Association of Washington Gas Utilities and have retained Robert C. Hayes of Seattle as vice president and executive director, according to Charles M. Sturkey, executive vice president and general manager of Washington Natural Gas Co., who is president of the new organization.

Mr. Sturkey said the group was organized to coordinate public relations and promotional activities of the industry, and to work with government officials and public agencies in administering regulations governing natural gas which is due in the Northwest next summer.

Mr. Hayes has been field director of the Association of Washington Industries for the past 10 years and is widely known in industrial circles throughout the state. He is a former Northwest newspaperman and public relations consultant.

Members of the association, who serve 34 cities of the state, are Washington Natural Gas Co. of Seattle, Spokane Gas and Fuel Co., Cascade Natural Gas Corp. of Seattle, Twin Cities Gas Co. of Kelso-Longview, United Gas Corp of Camas, Natural Gas Corp. of Washington at Port Angeles, Olympic Gas Co. of Port Townsend, and Port-

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Snap size head you want into ratchet drive ring, from either side—it can't fall out. Dies reverse easily for close-to-wall threading. 00R and OR, ⅛" to 1"; 111R and 11R, ⅛" to 1¼"; 12R, ⅛" to 2". Free carrier with sets. Conduit and special dies available. Real work-savers—at your Supply House!

RIDGID *Bolt Threaders, too—No. 00R-B, ¼" to 1", National Coarse or fine thread, efficient drop-head dies.*

"Threaded Pipe—It's Tight—It's Best—Costs Less"

RIDGID

Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U. S. A.

land Gas & Coke Co., which serves Vancouver.

Incorporating officers of the group, in addition to President Sturkey, are: vice president Stewart Matthews, president of Cascade Natural; W. A. Cook, vice president of Portland Gas; Nathan H. Gellert Jr., president of Spokane Gas; and Leland Jones, Northern division manager of Washington Natural, secretary-treasurer.

"The association is an outgrowth of the former Committee of Washington Gas Utilities," Mr. Sturkey said, "which has been dealing with mutual problems of its members for several months.

"Natural gas will bring more energy to the Northwest than all of the hydroelectric energy of Grand Coulee, Bonneville and other private and public power dams combined. This is a tremendous opportunity to attract new industries, and Hayes will work with chambers of commerce and other groups in bringing them to the state."

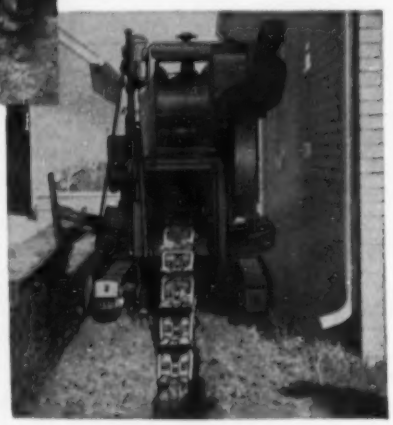
Hayes said the association office, at 1507 Fourth Avenue in Seattle, would carry on an educational campaign in the use of natural gas, coordinate exchange of industry information, and act as liaison with trade associations and governmental agencies.

The gas heat story is being carried to every part of Brooklyn Union's territory by the Charles W. Habacker trucking company, which totes gas appliances for the Brooklyn utility. Hating to see all that "floating billboard" space go to waste, BU's advertising department came through with the whole gas heat story in tones of blue and yellow when given the okay by the Habacker firm. Six vans will carry the gas heat legend to the more than 3 million people who are served by the company in Brooklyn and Queens.

"POW-R-DITCHER IS SUPERIOR FOR SMALL MAINS & SERVICES"

Says "Bud" Somerville and Supt. Jim Godwin of the
SOMERVILLE CONSTRUCTION CO., Ada, Michigan

"We have used several makes of ditchers and find the Vermeer 4T POW-R-DITCHER superior for installation of small gas mains and services. We get more footage with less destruction to landscaping. Our experience in this type of work covers a 15 year period and a great variety of ground conditions."



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This Vermeer "Midget Ditcher" is just the machine for laying gas pipe, service lines and digging foundation footings. Only 42" wide 6' high, 13' long. Digs 6" to 14" wide and can be transported in a pick-up truck. Same size moving parts as larger models. Write for name of distributor and full information on the complete POW-R-DITCHER line.

Some Excellent Sales Territory Available

VERMEER MFG. CO., Pella, Iowa

Washington Natural starts Seattle changeover surveys

Surveys preliminary to changeover of customers' gas heating equipment and appliances to accommodate natural gas have begun in north Seattle, David D. Risser, coordinator of natural gas changeover, Washington Natural Gas Co., has announced.

Conversions & Surveys Inc., under contract to make the changeover for Washington Natural's entire system when natural gas arrives late next summer, is making the surveys, which will continue through March.

Heating customers are being surveyed now, but the work will eventually include household appliances, Mr. Risser said. Data obtained will determine the adjustments necessary to make

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Malleable Iron Follower Glands

Strong — Corrosion Resistant — Light Weight — Sizes 2" thru 12"

High Strength Cast Iron Tee Head Bolts and Nuts

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TWO SWITCHES • BOTH *Automatic Recycling*

ELECTRICAL RATINGS
8 Amp. at 115 V, AC
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Motor Ratings: ¼ HP, 115/230 V, AC

● These Baso switches recycle automatically when a normal pilot flame is established. Service calls are fewer because when low pressure or other causes affect the pilot flame below a safe lighting condition, the switch breaks the circuit to the automatic gas valve and will automatically reclose the circuit, only when a normal pilot flame is restored. If the pilot burner goes out completely, the switch breaks the main valve circuit until the pilot burner is relighted.

Think of the headaches this will save you and your customers. Automatic recycling—fewer service calls. This with the Baso Automatic recycling switches, No. 860 for two-wire circuits and No. 861 for three-wire circuits.

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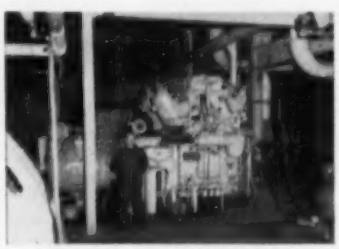

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equipment, now using manufactured gas, burn natural gas efficiently, and will be transferred to IBM cards to guide actual conversion operations.

E. W. Campbell, job superintendent of Conversions & Surveys, is directing the studies. During the changeover period, a crew of 350 specialists will make the adjustments at no charge to customers.

Seattle has been divided into 25 sections, Risser said. Sections will be changed over one at a time with present plans calling for three per week, he said. Section 20, in the vicinity of Renton, nearest to the company's south pipeline city gate, will be the first to get natural gas.

Sectional conversions will progress through the center of the city to the canal from the south city gate, and from the north city gate to the canal.

Utilities budget millions for '56 construction

Among major expansion programs scheduled by the gas industry for 1956 is that of Washington Natural Gas Co., Seattle, which will spend $8 million of its $22 million-five-year plan. Southern Counties Gas Co. has budgeted $19,645,000 for plant improvements—the largest amount ever set aside by the utility for such purposes in any one year of its 45-year history.

Northern Illinois Gas Co. will spend an estimated $74 million on construction during the next four years, $21 million of which will be spent in 1956. An $89 million construction and improvement program for 1956 has been announced by Dan E. Karn, president of Consumers Power Co. Of this total, $17 million is for gas facilities. Many western Pennsylvania communities will benefit from a $13.5 million expansion and general improvement program scheduled by the Peoples Natural Gas Co.

Automation's future predicted by experts

Industrial investment in automatic controls now represents between 8 and 10% of total dollars spent on facilities, according to an estimate made by Paul B. Wishart, president of Minneapolis-Honeywell Regulator Co. As forecast by Mr. Wishart, the multi-billion-dollar automatic controls industry is on the threshold of the brightest year it has ever known.

In his year-end review, the executive said the business of producing and selling equipment to do things automatically is growing at a more rapid rate

than the nation's general economy. As an example, he cited the homeheating and air conditioning fields, pointing out that the number of automatic homeheating installations had increased some 400% in the last 10 years to a total of 17 million.

Henry F. Dever, president of Honeywell's Brown Instruments division, does not believe that 1956 will bring many radical new and different developments in the field of automatic controls or automation, but will be characterized by consolidation of gains already made and continuing expansion of applications. The implication is not the slowing of engineering or new production development and techniques, but rather that these things will come more gradually than some predict.

Kansas and Colorado gas properties sold

Purchase of four Colorado and Kansas natural gas companies has been announced by Ralph J. Wann, an associate of Texas Millionaire R. D. Murchison. Sale price was $3 million.

Mr. Wann said the firms would be consolidated into the Plateau Natural Gas Co. with headquarters in Canon City, Colo.

The four companies and the towns they serve are:

Kansas-Colorado Utilities Inc.—Lamar, Granada, Holly, Walsh, Springfield, Wiley, McClave, Bristol, Hartman, and Vilas, Colo.; Ulysses, Johnson, Syracuse, and Kendall, Kan.

Pike's Peak Natural Gas Co.—Lyman, Hugo, and Eads, Colo.

Midwest Natural Gas Co.—Florence, Portland, Fountain, and Castle Rock, Colo.

Goodland Natural Gas Co.—Goodland, Kan.

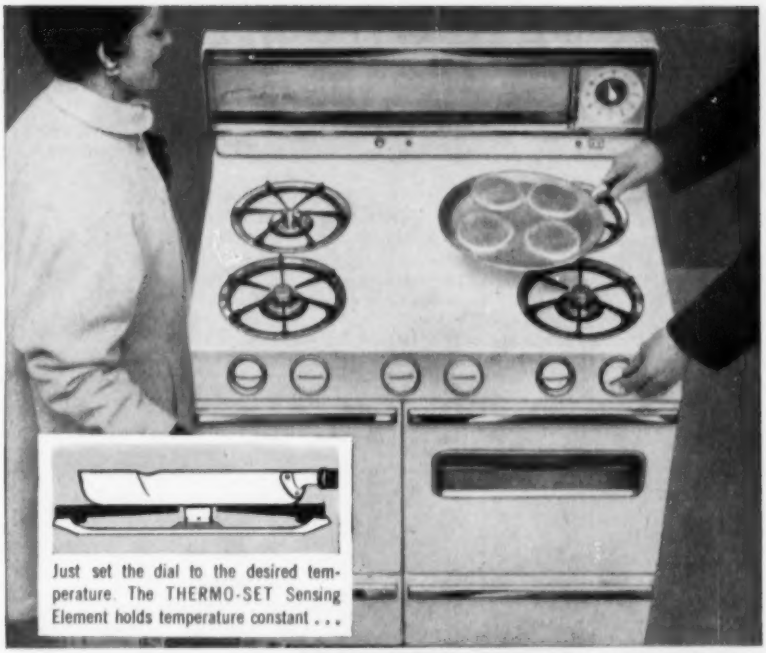
Loran Laughlin, owner of the Goodland firm since 1945, organized the Pike's Peak company in 1947 and the Midwest company in 1948. He said he planned next to develop gas properties in Utah.

Appliance shipments continuing 1955 pace

Gas central heating units shipments continued their record-setting pace during November, GAMA reports, when gas-fired boiler shipments exceeded the previous full year mark set in 1954. The shipments of gas-fired warm-air furnaces exceeded the previous record full year mark in October.

Boiler shipments to dealers and distributors reached 7800 units during November, up 1.3% over the same

Continued on page 94



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Here's Caloric's most demonstrable feature yet! You can put this great sales-maker into action right before your customer's very eyes.
Just connect your range to gas, turn the top burner dial and get set for sales! Show her delectable eggs without burning, bacon with no smoke or spatter, golden-brown fried foods, not soggy or greasy. With Caloric THERMO-SET it's goodbye to guesswork. No more burning, scorching, boilovers! No more endless watching. Just demonstrate it and you'll sell it.

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Expressly designed to provide greater warmth . . . more comfort. The easiest of all to clean . . . inside and out . . . Here's why: wide service door, entire lower back area fully open, top louver lifts out.

Exclusive directional louvers direct the heat at an angle into the room and away from the walls . . . affording better circulation . . . cleaner walls . . . Only Peerless has it.

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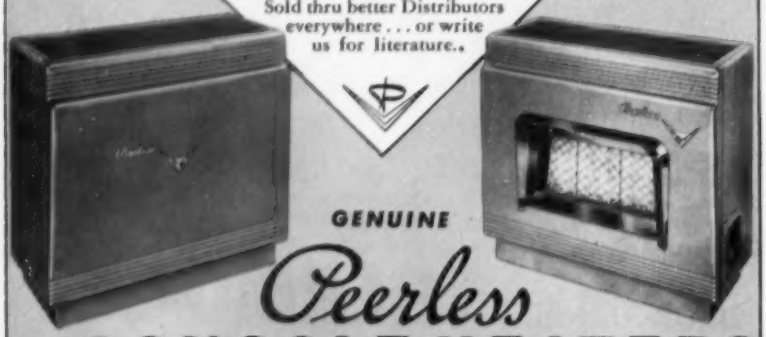

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GAS calendar

February

6-8..PCGA Home Service Conference — Hacienda Hotel, San Pedro, Calif.

9..NEGA Commercial Heating, Industrial Division — Hotel Statler, Hartford, Conn.

10..NEGA Manufacturers, Distribution Division Sales Managers Conference — Hotel Statler, Boston.

16..NEGA Accounting Division—Hotel Statler, Boston.

15-17..Tulsa Corrosion Short Course for Pipeliners (NACE) — Mayo Hotel, Tulsa.

16-17..SGA Accounting Management Conference and Sales Executives Conference — Jung Hotel, New Orleans.

March

1-2..SGA Distribution Management Conference and Transmission Management Conference — Jung Hotel, New Orleans.

12-16..National Association of Corrosion Engineers Annual Meeting — Hotel Statler, New York.

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

22-23..Oklahoma Utilities Association Annual Convention — Biltmore Hotel, Oklahoma City.

April

3-4..AGA Research & Utilization Conference — Cleveland.

4-6..AGA General Management Section Spring Conference — Conrad Hilton Hotel, Chicago.

13-14..Florida-Georgia Gas Association General Management Conference — Lakeside Inn, Mount Dora, Fla.

14-15..SGA Conference on Electronic Computers — Hilton Hotel, El Paso.

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

16-19 AGA Sales Conference on Industrial & Commercial Gas —Hotel Roanoke, Roanoke, Va.

17-19 Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

19-20 Indiana Gas Association — French Lick Springs Hotel, French Lick, Ind.

19-21 GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

23-25 Southern Gas Association Annual Convention—Dallas.

23-25 AGA-Midwest Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

May

6-9 LPGA Convention and Trade Show—Conrad Hilton Hotel, Chicago.

7-10 AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

7-11 AGA Commercial Gas School — Edgewater Beach Hotel, Chicago.

10-11 AGA Gas Supply, Transmission & Storage Conference—Conrad Hilton Hotel, Chicago.

16-18 AGA Chemical Engineering & Manufactured Gas Production Conference — Philadelphia.

22-24 Pennsylvania Gas Association —Pocono Manor Inn, Pocono Manor, Pa.

24-25 Natural Gas & Petroleum Association of Canada—Sheraton Brock Hotel, Niagara Falls, Ont., Canada.

June

26-29 Canadian Gas Association — Manoir Richelieu, Murray Bay, Quebec.

25-26 Michigan Gas Association—Grand Hotel, Mackinac Island, Mich.

September

5-7 Mid-West Gas Association Gas School and Conference — Iowa State College, Ames.

11-13 Pacific Coast Gas Association Annual Meeting—Coronado, Calif.

October

Week of Oct. 15 AGA Annual Convention—Atlantic City, N. J.

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The illustration above shows you how, with the simple turn of one selector switch, the M.S.A. Gascope gives you both high sensitivity for the detection of low gas concentrations, and immediate, quantitative response for tracing higher concentrations of gas to its source. Separate scales for each range are calibrated on the fan-shaped meter in the center of the instrument. Each scale is divided by 50 graduations to permit accurate, fast readings.

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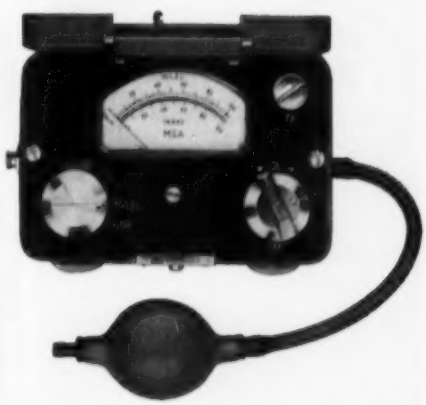

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Servicing Gas Industries For Over 40 Years

Continued from page 91

month last year. In so doing, shipments for the 11-month period totaled 84,900 units, an amount greater than the 80,200 shipped during all of 1954, the previous record year.

Gas-fired warm air furnace shipments set a new record for November with 78,200 units, a gain of 21.6% over November 1954 while shipments for the 11-month period have soared to 782,100 units, a gain of 29.1% over 1954, which had been the record holder.

Conversion burner shipments continued to show strength, reaching 21,300 units, a gain of 33.1% over last November. This boosted the 11-month total to 201,100 or just 6.6% behind 1954's pace. The last half of the year was a substantial one for conversion burners since they were more than 30% behind last year's shipments at the six months' mark.

Still on the increase were domestic gas range shipments, which continued to widen the distance between 1954's figures.

During November 182,000 units yere shipped to dealers and distributors, compared to 174,000 shipped during November 1954. This was an increase of 4.6%.

This makes a total of 2,099,600 shipped during the first 11 months of the year, an 11.8% increase over the 1,877,500 shipped in the same period in 1954. The figures do not include built-in ranges.

Fifteen gas companies "excellently managed"

Fifteen gas companies have been labelled "excellently managed" by the American Institute of Management, which presents the award to "bring deserved recognition to those companies whose managements are doing most to increase productivity, with accompanying benefits to employees, shareholders, their community neighbors, and to the economy as a whole."

The companies are: Pacific Gas & Electric Co., Pacific Lighting Corp., American Gas & Electric Co., Cincinnati Gas & Electric, Washington Gas Light, El Paso Natural Gas, Iowa-Illinois Gas & Electric, Lone Star Gas, Oklahoma Natural, Panhandle Eastern, Portland Gas & Coke, Niagara Mohawk Power, Equitable Gas, Baltimore Gas & Electric, and Consolidated Edison.

PG&E, Pacific Lighting, and Baltimore Gas received the award for the sixth consecutive year. Four companies—American Gas, Cincinnati Gas, Washington Gas, and Panhandle Eastern—received the designation for the fifth time in as many years.

"Voice of Management" ads launched by SoCounties

The gas service story is being told by Southern Counties Gas Co. in a series of ads running in southern California newspapers.

Reports on the first ads in this "Voice of Management" series indicate high percentages of both men and women are noticing and reading them. The ads explain the general cost of doing business, talk about rates and services, and seek to create a favorable impression of the company in the minds of the readers.

The ads usually picture a housewife, and quote her as saying "I've lived in a lot of places—and I know you can't beat the gas service you get here," or "I've never known such good gas service as we get here in southern California."

New system permits one-call service order

With the installation of a Bell telephone-Kardex combination, service operators in the customer service record department of Consumers Gas Co. of Toronto can receive, dispatch, and record service orders in one call.

The unit is composed of a Bell Telephone order-taking telephone equipment and a Remington Rand Kardex system. Customers reach the office over direct lines. There are 16 operators on duty and each has on her desk a set of compact key boxes, each with 15 lines. Surrounding the operators' desks are Kardex cabinets containing file cards with complete service data.

On receiving a call, the operator goes to the cabinet, where she plugs in the cord associated with her headset and continues the conversation. In this way she can complete her customer's service requirements on the original call.

B. C. Electric granted gas rights in Fraser Valley

B. C. Electric has won out over Valley Natural Gas Distributors in the fight to see which company would distribute natural gas in the Fraser Valley of British Columbia.

Although the PUC approved B. C. Electric's plan, the franchise carries a proviso allowing municipalities involved to set up their own gas distribution systems. The order specifies that any municipality can indicate before Feb. 2, 1956 that it wishes to make its own arrangements. But if it does and hasn't supplied gas by April 1, 1957, the certificate for that municipality will go to BCE.

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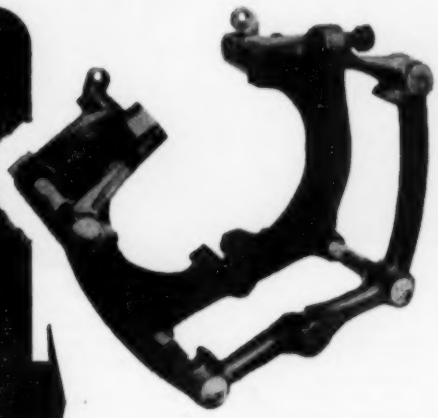
BELL JOINT CLAMP

A SIMPLE SOLUTION for one of the GAS INDUSTRY'S *most trying problems*



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6 inch Normac Clamp being lowered into hole for installation.

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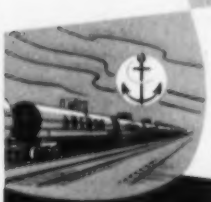

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GAS news notes

The Beaullieu Air Conditioning & Heating Co., Lafayette, La., and the Mechanical Equipment Co., Mobile, have been appointed as distributors of Servel air conditioning products in their respective trading areas.

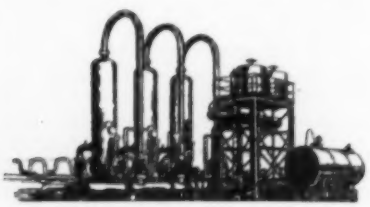
Oklahoma Natural Gas Co. is building a new service center at Shawnee which will cost $135,000 and contain about 10,000 sq ft of floor space. About one-third of the space will be used as office facilities for the Shawnee district operating department while the remainder will consist of warehousing and shop facilities for materials and supplies, construction equipment, meter shop, and utilization facilities.

Dollinger Corp., Rochester, N. Y., has appointed Malcolm W. Black & Co. Inc., New York City, as sales representatives for New York City, northern Jersey, and Westchester county.

Automatic Electric Co., Chicago, will build a new multi-million dollar factory, research laboratory and general office structure about 15 miles from downtown Chicago in Northlake, Ill. The overall structure of the $16 million facility will contain approximately 1.3 million sq ft, or 29 acres of floor space. Completion is expected by late 1957.

Purchase of all of the outstanding common stock of the Conoflow Corp., Philadelphia, has been completed by Walworth Co., as its fourth major acquisition within six months. Conoflow will be operated as an independent subsidiary without change in management, employees, or present policy.

A new distribution service center for United Gas Corp, will be constructed immediately in Houston, according to E. M. Cannon, Houston division manager in charge of distribution operations. A similar center now under construction is expected to be completed in March. Both centers are part of a long-range decentralization program of service facilities, maintenance, and construction work.



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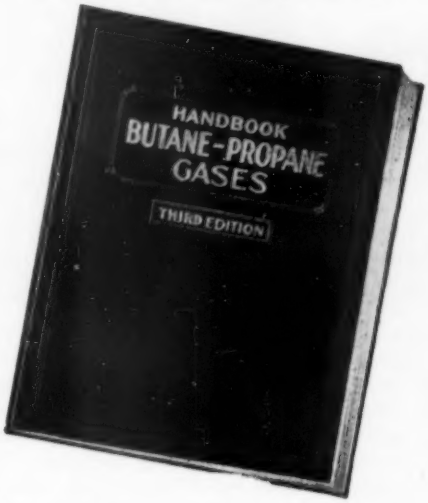

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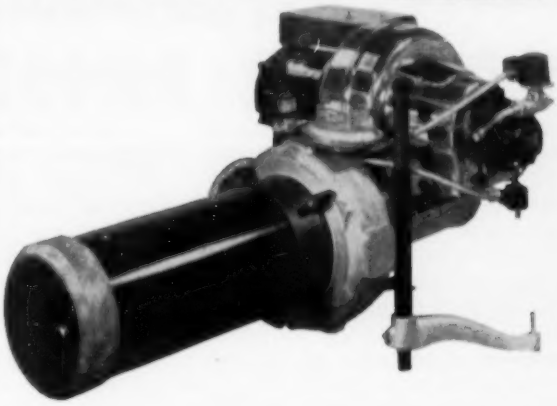

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The Webster Cyclonetic* Dual Fuel Burner is designed to operate on either gas or light oil with only the flick of a switch necessary to change from one fuel to another. Employing 100% forced draft, the Cyclonetic* provides fully automatic operation on both fuels, with complete programming and safety built in.

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Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

Who will distribute natural gas in Idaho?

THE 10-month legal battle for the southern Idaho distribution of natural gas ended when, following an Idaho supreme court decision, (GAS, December, p 62) the Idaho PUC reversed an earlier decision and granted the certificate of convenience and necessity to Intermountain Gas. As of Dec. 6, Intermountain will be the distributor for natural gas in southern Idaho. However, George Carpenter, president of Idaho Natural, the firm first awarded the certificate, said that the company would carry the case through "every recourse of law possible including the Supreme Court." At last report, no action has been filed.

Edwin Lessinger, 50-year-old Boise plumbing and heating contractor and president of Intermountain Gas, said that plans are underway to obtain as many local franchises as possible. A representative will be sent to each of the 30 communities that the company is entitled to serve.

In stressing the "all Idaho" make-up of the company, Mr. Lessinger said that all common stock will remain in Idaho, but that preferred stock and first mortgages will be sold through out-of-state bonding houses.

Intermountain was organized in 1952, two years before petitions were filed with the Idaho PUC in September 1954.

Another factor in the uneasy gas distribution picture in Idaho has been the formation of cooperatives to distribute gas within the various cities and communities.

Many municipalities are caught hard in the bite between the need for increasing services and tax levy limitations. An effort was made at the last session of the legislature to get the law-making body to consider a bill enabling the cities to finance a gas system through revenue bonds. The efforts failed and the Idaho attorney general ruled that existing state law does not permit the cities to form such a system.

Several cities, notably Idaho Falls with its own power plant, and Burley with a power distribution system, have long been interested in municipal ownership. Therefore, many were ready to listen when representatives of two Omaha investment firms, Wachob & Bender, and the W. E. Schweser Co., proposed a plan whereby a cooperative could be formed to distribute the gas within a city. The investment company would be repaid by the cooperative and when the debt was liquidated, ownership of the system could go to the city or remain with the cooperative. The obligation of the city, legally, rested only in granting the franchise to the co-op and in providing the city regulations necessary for gas distribution. A similar plan was also proposed by a Salt Lake City firm.

In one case, probably typical, representatives of the investment firm presented the plan to city council members in an informal meeting. There is almost a "something-for-nothing" air about the plan. The city gets a gas system in 15 to 25 years in the future for granting the franchise. In one community, a house-to-house poll was taken to determine the interest or lack of interest in a co-op.

The plan, following some study, is presented in the public council meeting and public hearings are scheduled. Typical of the hearings was the one in Twin Falls where public versus private ownership was hotly debated. One fuel oil dealer said, "Gas will be competitive with fuel oil and I have no desire to pay taxes to my competitor." Following two public hearings, Twin Falls decided against a cooperative plan.

Cooperatives have incorporated in 10 towns, local franchises have been granted in only two, Burley and Alameda, a suburb of Pocatello.

Idaho Falls, the third city in population in the state, was left out from the distribution plan of Idaho Natural and originally figured that at least $1.5 million would be needed to bring natural gas to the city. Mayor Milo Fanning says that the change of distributors has not changed Idaho Falls' interest in a cooperative plan.

Intermountain representatives have said that the legal position of the cooperative is not clear and will probably need to be established by court action.

In an address to the Idaho Co-operative Council an Idaho attorney, Eli Weston, said that these are not true cooperatives. "Democratic control is essential in a co-op, and that element is missing under this arrangement. They are directed by city officials and not the patrons."

Of the four major cities in the southern part of the state, Boise has evidenced no interest in the cooperative plan; Pocatello has formed a cooperative but has not granted the franchise; Idaho Falls has formed a cooperative and evidences continuing interest in such a plan, and Twin Falls is ready to grant the franchise to Intermountain. ■

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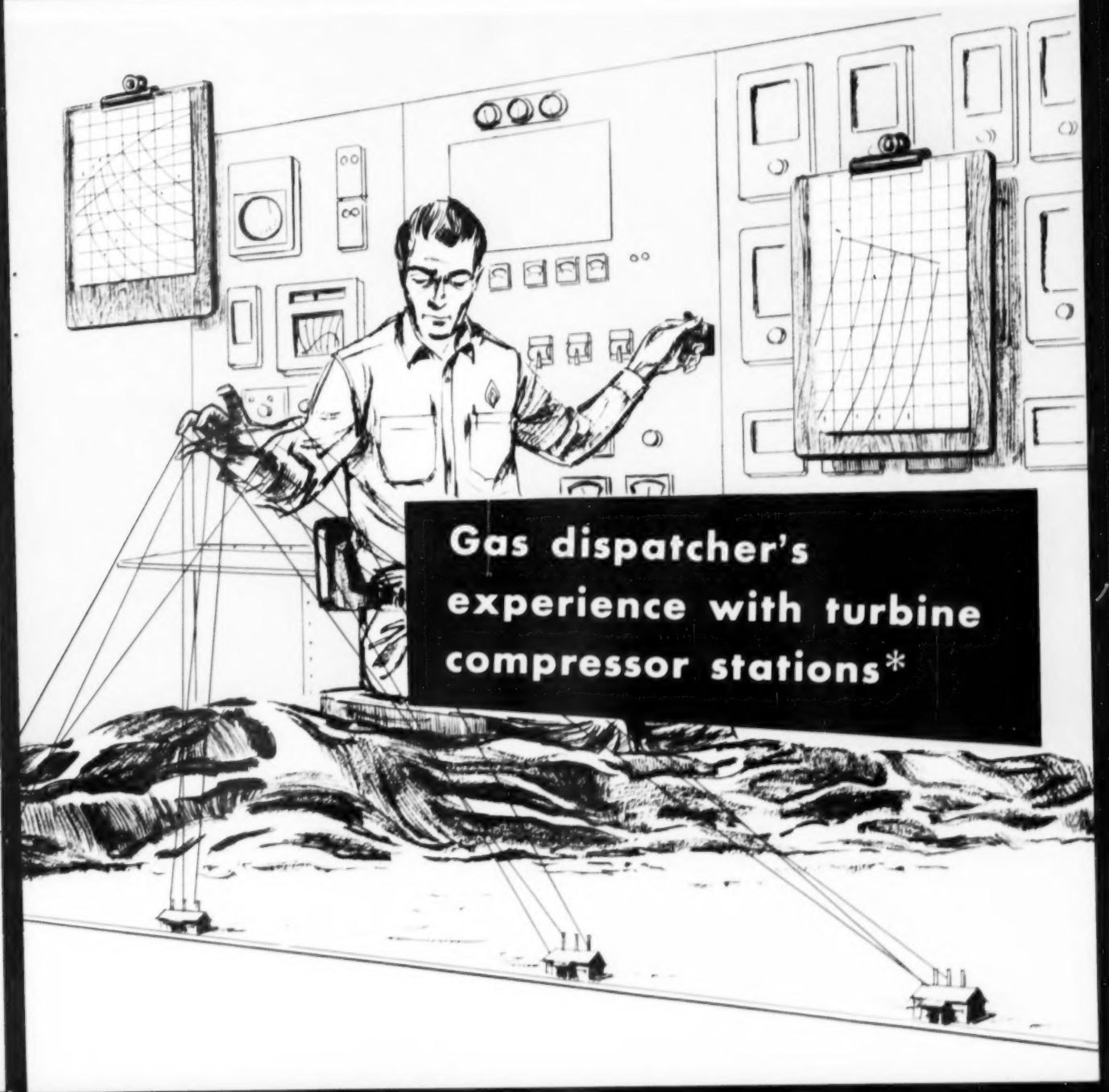

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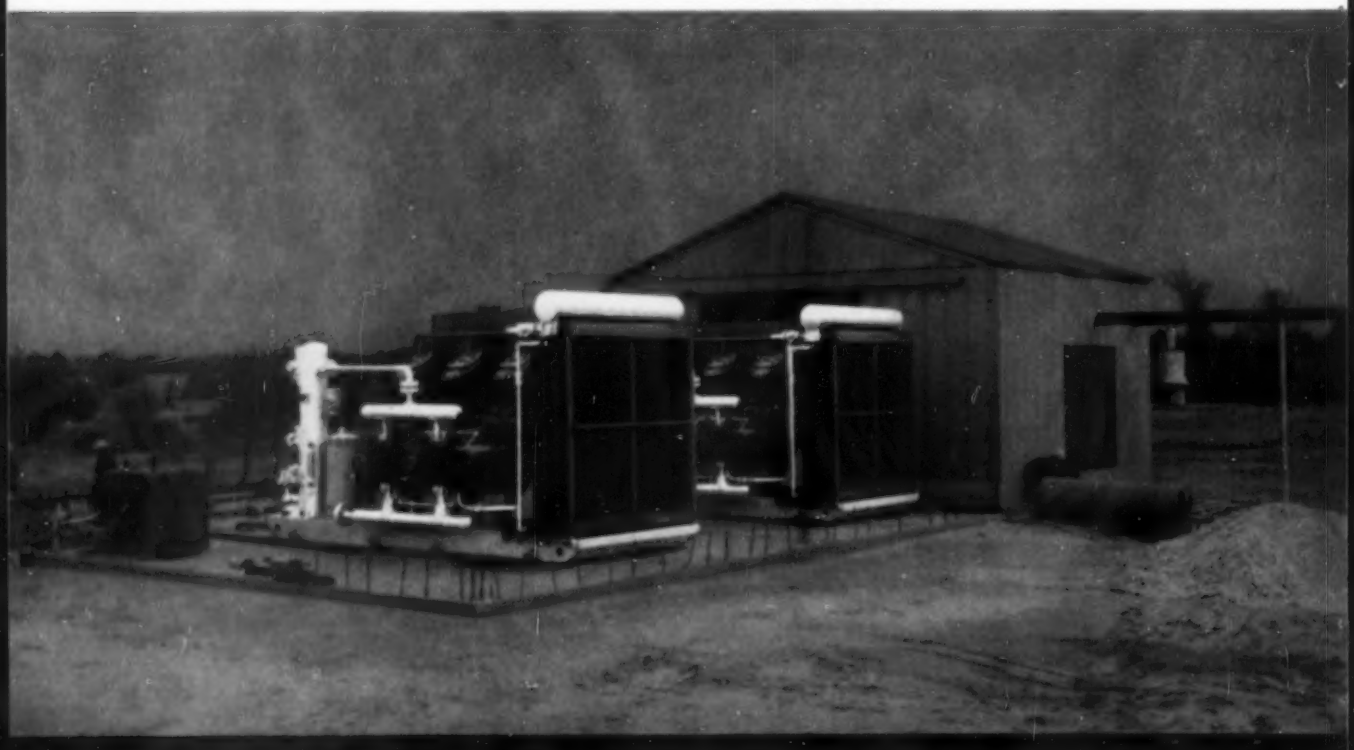

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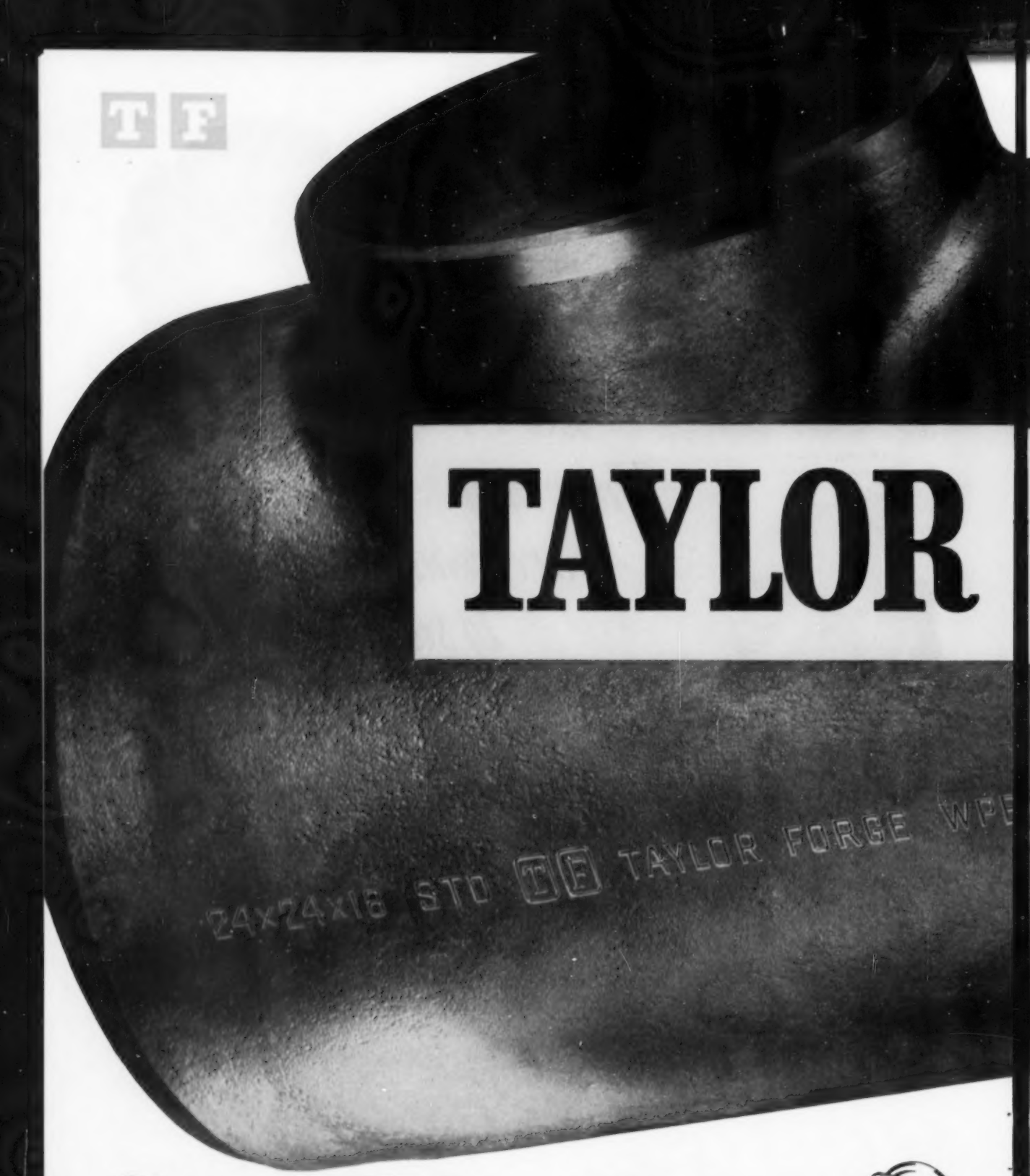

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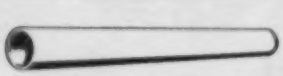

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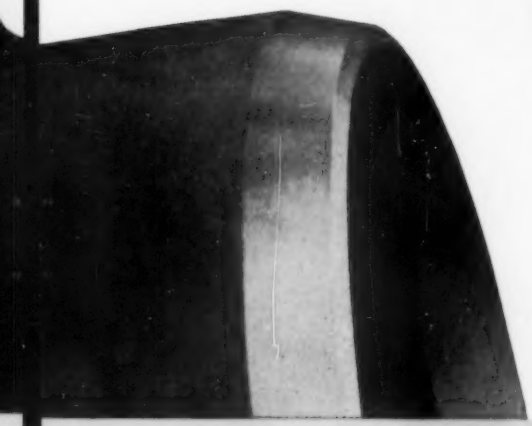

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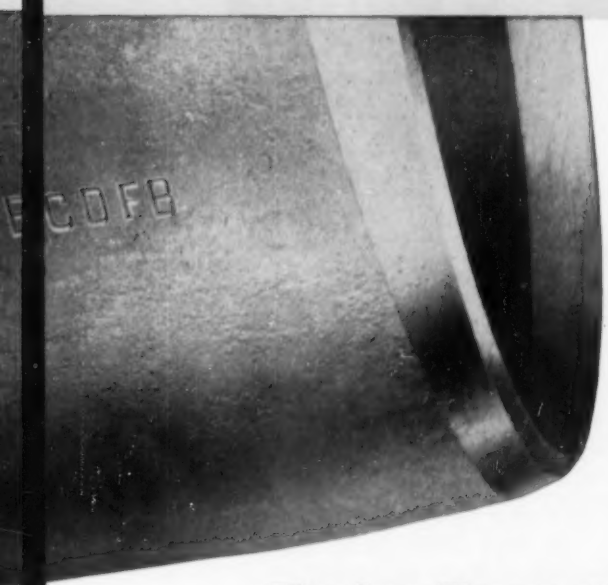

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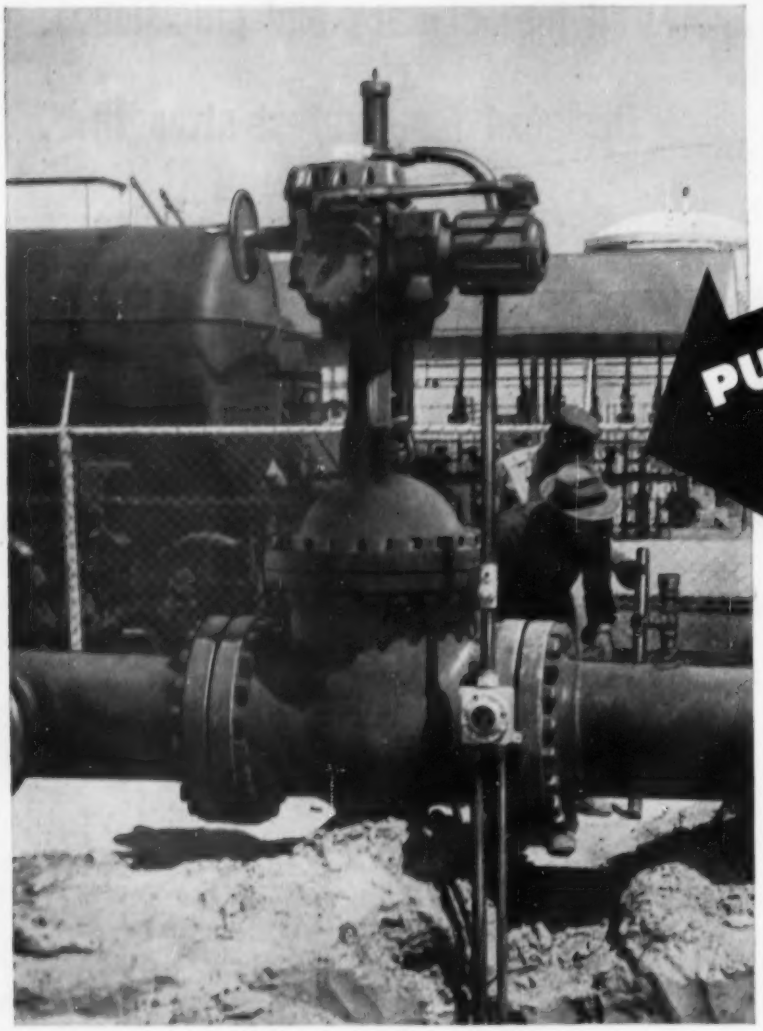

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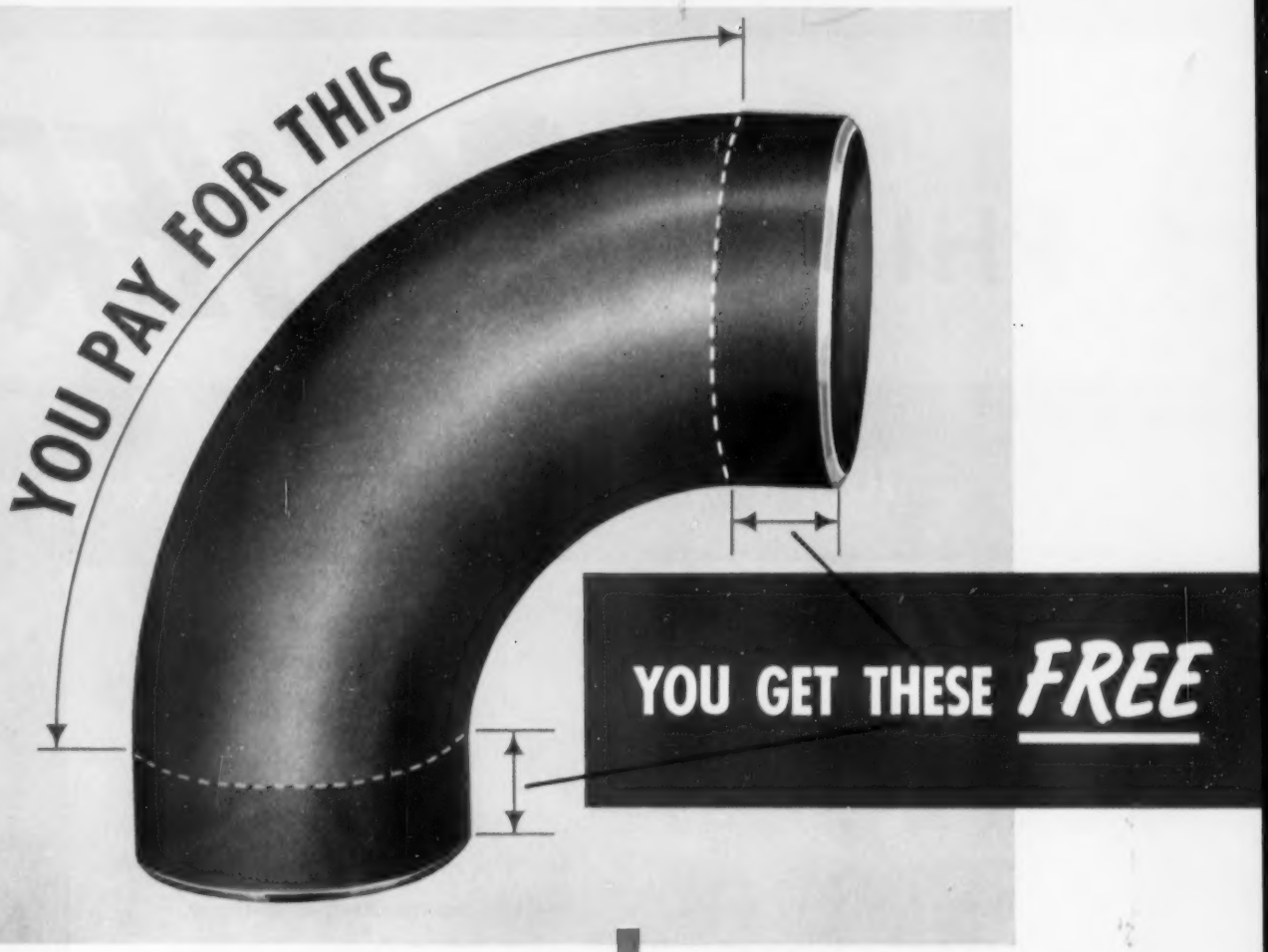

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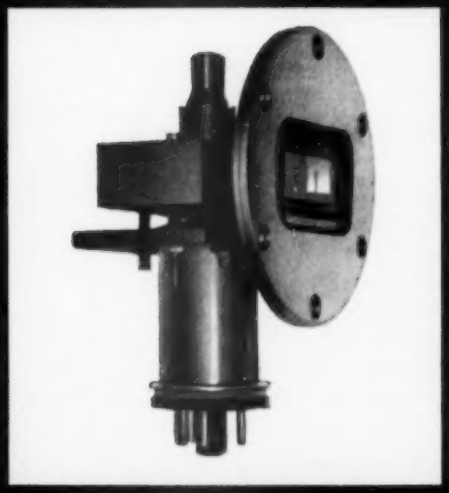

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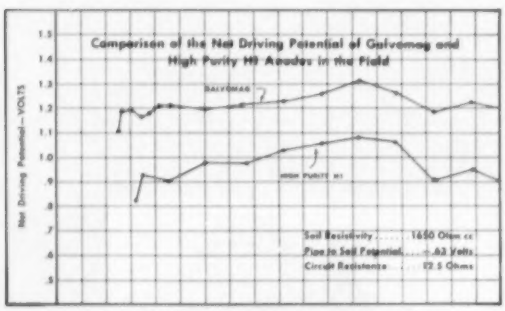

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Gas dispatcher's experience with turbine compressor stations

GAS
FEBRUARY 1956

● By H. B. LAFFERTY, Chief Dispatcher • El Paso (Texas) Natural Gas Co.

As experience with combustion gas turbines as prime power units for gas transmission compressor stations is gained, the results are enabling operating men in various departments to tailor routines to produce advantageous performance. Gas dispatching is directly concerned, so the experience of El Paso's Chief Dispatcher bears out the contention that the gas turbine driven centrifugal compressor is the right machine for its application.

OPERATING characteristics of combustion gas turbines driving centrifugal gas compressors caused many misgivings and apprehensions among the operating personnel and management of El Paso Natural Gas Co. from the time the turbine-centrifugal compressor program was proposed until long after the first unit was in operation.

The doubts expressed were the result of frequently heard stories such as:

1. The high frequency sound waves generated by this equipment would cause many cases of deafness and nervous disorders among operating personnel. This is not true. There were a number of people who had to be transferred out of the turbine stations, but no more, and perhaps not as many, as are found that cannot work in a reciprocating station.

2. The loss of a station anywhere on the line would cause turbine stations both upstream and downstream to fall off the line like a row of dominoes when one is tilted over. This is in part true, but compensations can be made to overcome this and will be covered more thoroughly a little later.

3. A sudden change on the throughput at one of these stations would cause the centrifugal compressor to surge, and the results would be disastrous. This is as true as it can possibly be, except that up to the present nothing disastrous has happened. Station personnel have learned how to cope with this problem and minimize, to a great extent, its danger. A possible solution to this problem is flow measurement, or indication of flow, at each turbine station and rapid or almost automatic communications.

These and many other stories were heard, some of which were true or partially true; but none has proved insurmountable. In fact, the advantages of such equipment in a transmission system far outnumber the faults that may seem to be apparent at this point.

The first of these units went into operation in September 1952. By December 1953 there were 28 units (representing 140,000 hp) spread over 750

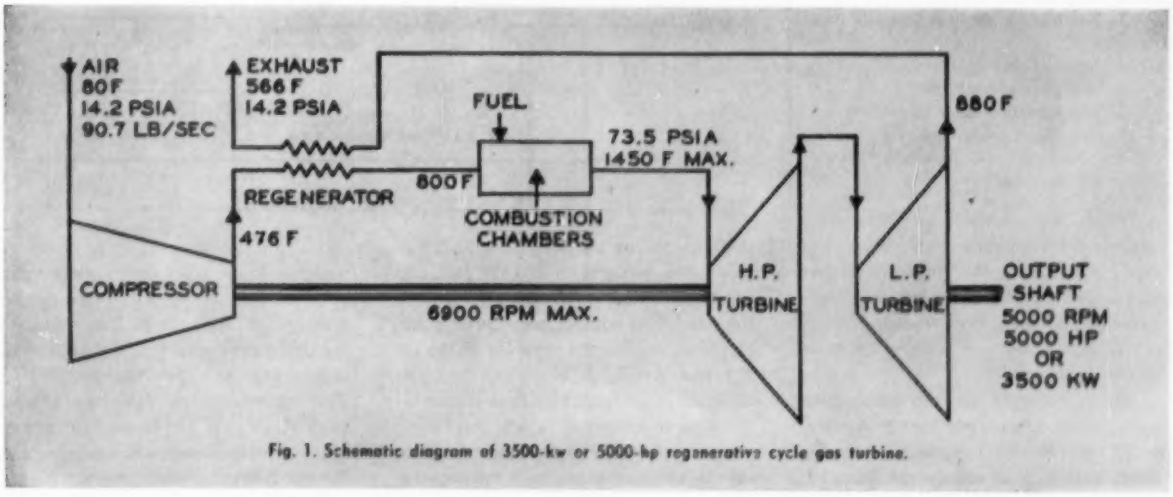
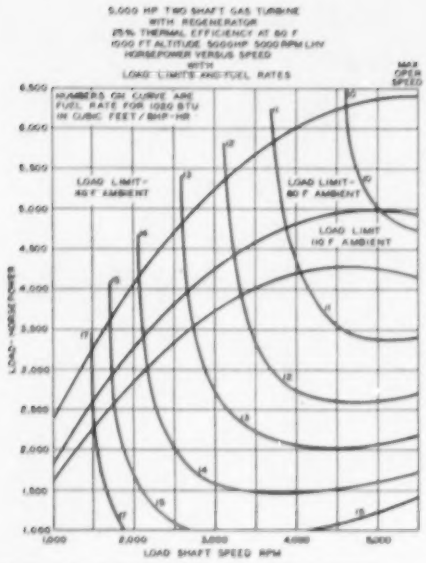


Fig. 1. Schematic diagram of 3500-kw or 5000-hp regenerative cycle gas turbine.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LOAD SHAFT SPEED RPM

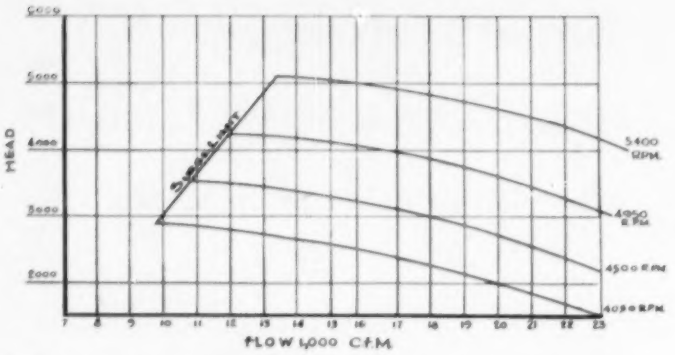
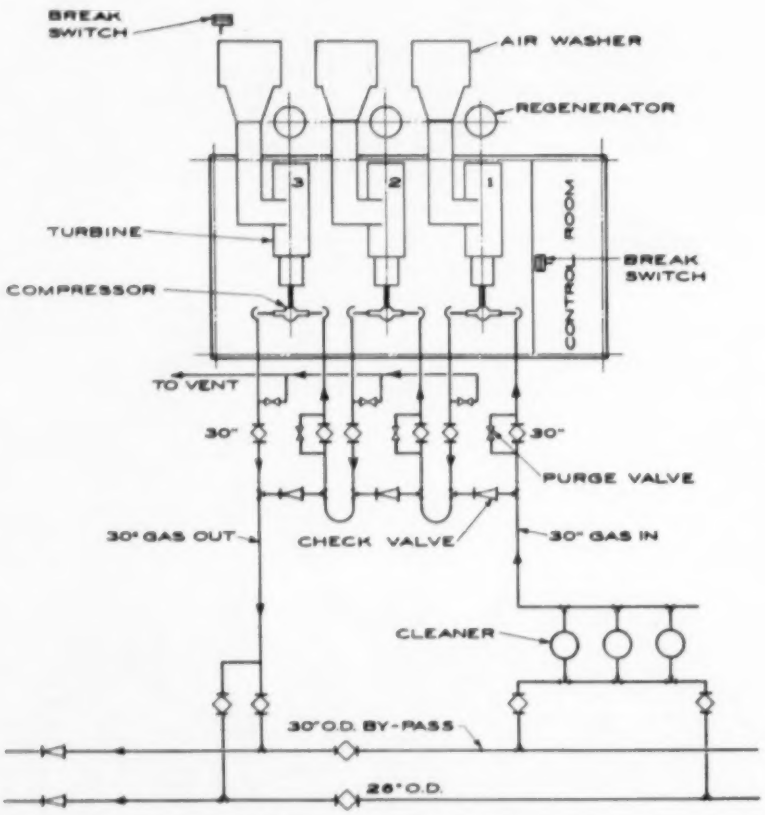


Fig. 2. (left). Load and horsepower for varying speeds and varying ambient temperatures.

Fig. 3. (above). Mixed flow wheel centrifugal characteristics.

Fig. 4. (below). Three-unit gas turbine centrifugal compressor station, showing station piping.



miles of 26- and 30-in. lines in loop operation, and turbine stations located between existing, conventional reciprocating stations on mainline service, with stations spaced at approximately 30-mile intervals. These units were doing their part in sending gas from the Permian basin in Texas to delivery points in California.

The turbine station itself is a complicated network of piping, automatic valves, and automatic electrical controls. No effort will be made here to describe the station in detail, but an attempt will be made to supply enough information to provide a basic understanding of this type of equipment.

There were certain advantages offered by the gas turbine, which influenced its choice for installation, as will be decribed later. These advantages are as follows:

1. Flexibility of speed at full load conditions.
2. Automatic station control.
3. Low maintenance cost.
4. Low operation labor cost.
5. Low construction cost.
6. Additional power available during low ambient conditions.

Only a few of these advantages actually help the dispatcher in carrying out his job. In order to fully understand the reasoning behind these advantages of the prime mover, let us first describe the gas turbine cycle as shown in *Fig. 1*.

Air is brought into an axial flow compressor, through an air washer, which serves two functions: (1) To clean, and (2) to reduce the inlet air temperature by evaporative cooling. The air is brought in at 14.2 psia and compressed to approximately 73 psia by the axial flow compressor. During this compression, the temperature of the air is raised to 476° F. The air is then discharged from the axial flow compressor to a regenerator, which serves the purpose of recovering part of the heat in the exhaust gases and applying it again into the working cycle of the gas turbine. In the regenerator, the air temperature is raised from 476° to approximately 800° F by the exhaust gases that are being exhausted into the inlet of the regenerator at approximately 880° F. The exhaust gases leave the exhaust stack at 566° F. The heated air coming from the regenerator is then fed into the combustion chambers where natural

gas is added and the combustion raises the temperature of the compressed air to 1450° F. These hot gases are then fed into the high pressure turbine, which is connected directly to the axial flow compressor. In the high pressure turbine, part of the energy is removed from the hot gases to drive the axial flow compressor. The hot gases coming from the high pressure turbine are then fed through variable nozzles into the low pressure turbine that is directly coupled to the centrifugal compressor.

It should be mentioned at this time that in order to maintain the highest efficiency on the gas turbine, it is necessary to use the split shaft arrangement so that the high pressure and low pressure wheels are run at different speeds. This allows the operator to maintain an exhaust temperature of 880° F for variable loads. This speed controlling is done with automatic nozzles which properly adjust the speed of the axial flow compressor so that sufficient air is fed to the combustion chamber to maintain 880° F exhaust. We have described briefly the operation of the turbine for fixed conditions, as shown in *Fig. 1*.

To give an idea of the kind of prime mover we have and what its capacities are, reference should be made to *Fig. 2*, which describes the load and horsepower for varying speeds and varying ambient conditions. Also superimposed on this same figure are the fuel consumption rates for these various speeds and horsepower loads. It can easily be seen that when the ambient temperature drops to 40° F, approximately 6500 hp is available at the output shaft of the machine; however, the turbine is limited in horsepower by an increase in ambient temperature to the extent that

Turbine Stations... Gas turbines were found to produce 25% more hp for a 40° drop in ambient

at 110° F we can only get 4250 hp. This has not proven to be too much of a limiting factor, since our high horsepower requirements occur when low ambient conditions are predominant. It should also be noticed in this figure that for very low load shaft speeds the horsepower available is very low and the fuel consumption rate, measured in cubic feet per brake horsepower hour, is about 70% higher than it is at full load. These are the important factors of gas turbine operation that the dispatcher should keep in mind. Let us review them again:

1. We have almost 25% more horsepower available for a 40° drop in ambient.

2. Idling of the gas turbine is a very inefficient operation since we are using 70% more fuel at idling speeds than we are at full load speeds.

The centrifugal compressor that we are using in connection with our turbines has a characteristic that is shown in *Fig. 3*. This figure shows the head output for various speeds and various flows, and it also shows the limiting factor of the machine, which is the surge line shown on the left-hand side of the figure. This type of compression comes about by feeding the gas into the inlet of an impeller, which raises the speed of the gas up to the discharge side of the impeller. There is very little static pressure rise within the impeller, but the energy being given to the gas here can be best described as velocity head. The gas is then fed through a diffuser where the velocity head is converted to static head, and the gas is then fed back into the pipeline at a higher pressure through the volute. Now we have the two important descriptions for a centrifugal compressor, one being how the gas is compressed within the centrifugal compressor, and the other being the compressor characteristic itself, which shows the dispatcher the limitations of the machine.

Fig. 4 describes the station gas piping. The gas is fed into the station from a 30-in. and a 26-in. line, through two station block valves, and then is manifolded together at the suction side of the scrubbers. The gas feeds through the scrubbers into a single 30-in. line and moves into the first unit through a unit block valve. The gas is compressed in the centrifugal compressor and discharged through the unit discharge valve. The gas is fed back into the mainline through two station block valves. It should be noticed that there is a bypass arrangement across the piping of each unit, which will allow gas to bypass a unit that might be shut down.

Let us now look at the pipeline system itself, to give an idea of the number, location, and spacing of these turbines (see *Fig. 5*). Our first turbines are located at the Pecos river station. About 30 miles downstream we have Guadalupe, which is a reciprocating station, with approximately 25,600 hp installed. Downstream from the

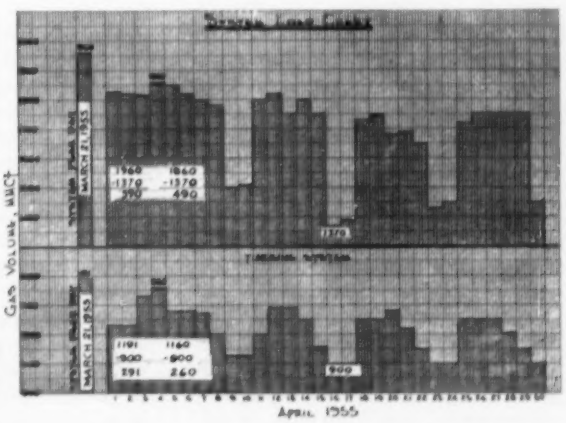


Fig. 5. (left). System map, showing turbine stations and their location with respect to the reciprocating stations. Fig. 6. (right). Load curves.

Guadalupe station is Cornudas, which has three 5000-hp gas turbines and following that is Hueco, which also has three 5000-hp gas turbines. Downstream from Hueco is El Paso compressor station, which is rated at approximately 28,000 hp. It should be noted that there are approximately 30 miles of pipeline between each station under the present conditions.

Next I would like to bring out the fluctuations in load that occur on the system as a whole and the turbine system by itself. In order to fully explain the problems encountered in the operation of gas turbine-driven centrifugal compressors, which we have experienced, it is necessary to show some of the operating conditions imposed upon them. It would be folly for me to presume to tell anyone how to operate his turbines for two reasons: (1) The operating conditions on the system may be entirely different from ours, thus creating different problems. (2) Design characteristics of the compressors are probably quite different from ours and under the same operating conditions would behave differently. Since our operation is the only one which I know anything about, please forgive me if I dwell on them at some length. Nothing makes a dispatcher happier than to talk about his problems.

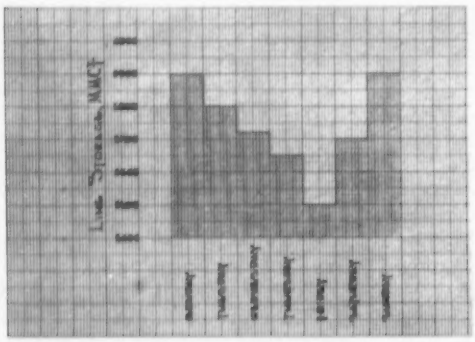
The source of most of our turbine problems, with respect to dispatching, stems from the wide load fluctuations that occur on our system. This system was designed to operate at a more or less constant rate of flow. *Fig.* 6 is a chart that shows what happened in April of this year together with the system peak day set on March 21. The top half of the chart represents the total mainline sales with 590 MMcf per day swing from the peak day on March 21, to the low day on April 16, and a 490 MMcf swing between the peak day and the low day during April. Not all of this swing occurs on the system in which the gas turbines are located. The lower half of the chart reflects this swing. The peak day through the turbine system was 1191 MMcf on March 21, and down to 900 MMcf on April 16, or 291 MMcf swing. The 28 gas turbine units increased our capacity on this system by 331 MMcf; so one can see from this range of requirements in two weeks time that we may have all, or most, of our turbines operating at one time and drop down to a point where volumewise none are needed.

To further complicate the picture, we purchase a great deal of residue gas, which is gas produced incidental to oil production, over which we have no control. This gas is "take or pay." On many weekends this minimum purchase obligation forces us to take more gas into our system than we can sell. We try to anticipate this and to sell out our line pack prior to the weekends. This provides, for a limited time, storage capacity for the surplus production. The line pack, from peak to minimum, can be swung 400 MMcf and under some conditions 500 MMcf. *(See Fig. 7).*

These flow and pack swings impose very severe operating conditions, which were not anticipated in the original design of the gas turbine stations. One of the characteristics of our centrifugal compressors is that they do not lend themselves to line pack and draft operation as well as reciprocating compressors; yet we are forced, because of our present dispatching requirements, to use the centrifugal compressors as line pack machines. This characteristic, in our case, is one of design and not necessarily true of all centrifugals.

In an attempt to meet these variable conditions, we first tried dropping the turbine stations off the line as load requirements indicated. But because of the lack of any symbol of stabilized line conditions, we found this would impose impossible operating conditions at stations still on the line. In an effort to get a station out of trouble and still meet our commitments, we would put one of the idle stations back into service and shortly found that we did not need the station that had been in trouble. Our line pressures in effect were being played like an accordion as we kept switching stations. The solution was fairly simple although not very efficient, horsepower-wise, since, as previously mentioned, the turbine uses 70% more fuel at idle conditions than it does under full load. To avoid this accordion action, we kept at least one unit on at each station regardless of how low the throughput fell and made our horsepower changes at the reciprocating stations. We found the turbine stations would follow the reciprocating stations like chicks following a mother hen. This also brought about another advantage from the standpoint of operation, since we reduced the number of starts and stops on the turbine. The reduction in the number of starts and stops also reduced the amount of maintenance required on each machine. *Fig. 8* shows a typical operation where changes have been made at the reciprocating stations and the turbines have followed without making unit changes, even though speed changes are sometimes necessary.

Another problem that the dispatcher faces in contending with the centrifugal compressor is that of the compressor surge. Surge occurs when the head across a centrifugal compressor increases to a point where the compressor can no longer overcome its discharge pressure. When this happens, the gas



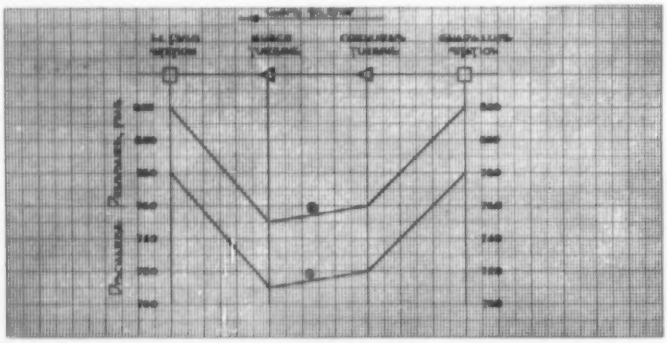


Fig. 7. (left). Typical storage swing. Fig. 8. (right). Typical operation, shows turbine station self-adjustment to reciprocating station changes.

slips or back-flows through the compressor and momentarily unloads or lowers the head being developed. When enough gas has back-flowed through the machine, and it has lowered the discharge pressure sufficiently so that the machine may pump against it, the cycle repeats and the gas flows in the positive direction. This cycle will repeat itself rapidly until some adjustment is made to eliminate the cause.

A cause of surge is low rate of flow. The low rate can be the result of flow changes that occur slowly. This type of surge creates no particular problem since it can be anticipated and speed or head adjustments made to avoid it. Another more violent surge condition occurs when the throughput is upset without prior notice, as happens when a station upstream or downstream drops off the line, or a section of loop pipeline is shut in or put into service too quickly; however, even under these severe conditions, surge can be avoided if station personnel are given prior notice of what to expect.

Most of our trouble is due to close station spacing, which gives very little time to notify operating personnel when an unexpected upset occurs. In cases where we have been able to give prior notice, the operator will slow his units back to idling speed and open the station block valve. He can then be pumping gas at a reduced rate in 10 minutes, when the pressure has partially equal-

Low rate of flow

ized across his station. If the upset comes without notice, his station may be tripped off by high vibration caused by surging and it may take him from 30 minutes to one hour to get it going. A typical example of this operation occurred recently when we lost one of our reciprocating stations for a few minutes. Within three minutes of the time it went down, the Afton turbine station, 30 miles downstream, was experiencing rapid pressure changes. Within seven minutes it had been tripped off because of surge and high vibration. However, the Hueco turbine station, approximately 30 miles upstream, was able to ride through this condition without any trouble because it started with a low discharge pressure and flow stayed high enough to prevent surge. These instances are few and far between, since the incident of losing a station unexpectedly seldom occurs.

Even with all the knowledge that we

Turbine Stations... Advantages and disadvantages of turbine centrifugal compressors can be summarized

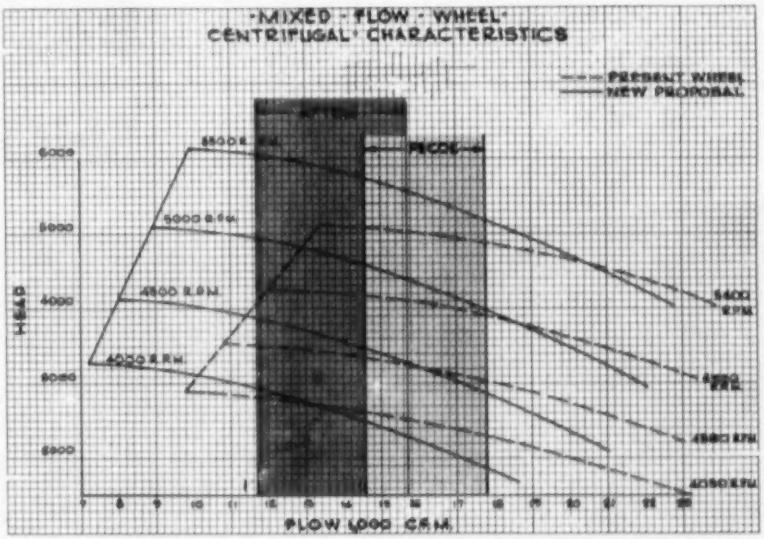


Fig. 9. Operating conditions to which Pecos river and Afton stations were subjected.

have learned in operation of the gas turbine-driven centrifugal compressors, we still do not have the problem completely solved as far as good sound operation is concerned. We found that occasionally the flow dropped too low. *Fig.* 9 shows the operating conditions to which Pecos river station and Afton station were subjected. It should be noted that under the most extreme conditions, Pecos river was in good shape as far as the surge was concerned; however, Afton, under the low flow conditions, was subject to surge above 4900 rpm. It can be seen from this chart that the wheels at Afton, which had similar characteristics, had to be changed out to give the proper operating conditions and efficient protection against surge. We are now in the midst of changing out the wheels at Afton to the new proposed wheels. Characteristics of both wheels are show on this chart. We estimate that our surge conditions will be reduced to a minimum when these new wheels are installed.

In conclusion, I would like to summarize for you some of the advantages and disadvantages of the gas turbine-driven centrifugal compressors.

The primary advantage to the dispatcher is that 25% or more horsepower is available under low ambient conditions. We have run calculations at our Pecos River station, during January, which indicate that the station, rated at 15,000 hp, was actually developing 21,000 hp. This helps us meet peak load conditions and also helps us overcome loss in line efficiencies. Secondly, the variable speed of the centrifugal compressor gives us a wide operating range without any mechanical adjustments of the compressor when the wheel characteristic is properly sized. Thirdly, the speed of response of the stations in being able to pick up the load is a strong advantage.

Pack and draft

The prime disadvantages of the gas turbine, as previously mentioned, are the surge characteristics of the wheel and its inability to pack the line without a lot of trouble on the part of the operators and close coordination with the dispatcher. As pointed out before, the inability to pack and draft is not necessarily true of all centrifugal compressors.

It can be said without any reservation, however, that the El Paso Natural Gas Co. is very well satisfied with the overall performance of the gas turbine-driven centrifugal compressor, and we definitely feel that we have chosen the right machine for its application. ■

THE BIG SHOVE

Operations base for the big shove is perched upon one of the few spots of relatively dry land in the area. The joints of pipe are welded on and the whole string pushed forward with a winch tractor. Note the string of floating barrels holding the pipe up in the ditch.

POSSIBLY the longest continuous pipeline "shove" in the history of the industry has just been completed in the Louisiana marshes by Brown & Root Inc.

In pipeline parlance a "shove" is the procedure of joining together lengths of pipe and floating forward the complete string as each joint is added. This push was made through a narrow water-filled canal 62,105 feet long or almost 12 miles. Nine thousand empty 55-gal. oil drums were used to float the 16-in. concrete-coated pipe through the channel. As many as seven drums to the joint of pipe were strapped on with wire in order to float the string. The total weight of the suspended pipe was 12,421,000 lb.

The big push was made three miles east of Cameron, La. a part of a 38-mile contract Brown & Root has with the American Louisiana Pipe Line Co.

Ed Minor, pipeline manager for Brown & Root. said the extraordinary undertaking was necessary when permission could not be obtained from the land owners to dig a flotation canal in which a lay barge could have been used in the conventional manner. The only other alternative was to dig a ditch and float the pipe through the 12-mile marsh, since the surrounding terrain was too marshy for land equipment. The only vehicles which could navigate the terrain were draglines mounted on marsh buggies and these were used to dig the ditch and guide the lead end of the pipe as it was pushed forward. The heavy pipe had to be shoved around the bends of two long curves in the water-filled ditch. A two-way radio between the lead marsh buggy and the pusher on the back was used to synchronize the string's movements.

With this particular section of land crossed, the next step of the operation will be another shove of 44,000 ft. of the same type pipe although this will be done from a lay barge in a dredged canal. ■

Close-up showing the barrels attached to the pipe as it goes into the ditch. Six or seven empty oil drums were attached to each joint by wire. When the pipe was in place the barrels were cut loose and the pipe allowed to sink into the ditch.

Upper left—Pushing concrete coated 16-in. pipe around a curve was one of the problems confronting Brown & Root's pipeliners. Note the floating barrels.

Above—Aerial view shows the ditch stretching miles into the distance of the flat Louisiana marsh.

Lower left—Less difficult will be the next section of line, which will be laid in the conventional manner from a lay barge shown in the picture. Here the pipe is joined together on the barge. The barge is then pushed forward while the joined pipe slips off the rear of the barge. The canal had to be dug to provide flotation for the barge.

How to design your pipeline

A pipeliner never gets to old or works too long for him not to be interested in the basic ideas behind the design of a gas pipeline. Here is an article in which the author has developed and illustrated the use of basic pipeline design formulae. It serves as a good review for experienced engineers and as a basic text for those getting started in the industry.

By S. D. FORD • Kansas-Nebraska Natural Gas Co., Hastings, Neb.

THE problem of designing a complete natural gas pipeline system is very complex. It includes selection of route; determination of need for processing equipment such as hydrocarbon extraction plants, sweetening plants, carbon dioxide removal plants, and dehydration plants; spacing, sizing, and design of compressor stations; selecting location for and design of river crossings; the determination of sizes, grades, and weights of line pipe to be used; plus design and rating of valve settings, fittings, pig traps, etc. The final selection for practically all of these items is usually based on an economic study which is made after the various possible solutions have been determined, so that the final overall design will be one that is economically sound.

This discussion will be limited to the problem of determining the sizes, weights and grades of pipe which may be used, and the spacing and size of compressor stations. In any engineering design problem two factors often conflict—safety and economy. The answer must be one that gives a safe, economical design.

The generally recognized standard for safety in design and construction of natural gas pipelines is the American Standards Association "Code for Pressure Piping." Section 8 of this code covers gas transmission and distribution systems. Compliance with this, or any other, code is not compulsory in most states, but such compliance is generally considered desirable. Persons working on pipeline design problems should be familiar with this code and any others that might be applicable in a particular situation.

The design must be economically sound, because the basic reason for expending the large sums of money required for construction of a modern pipeline system is to obtain a fair profit for the investors who furnish the money that makes the project possible. If a project will not yield a satisfactory profit, the investors will not make the money available, and the pipeline, no matter how well designed from the standpoint of safety or any other basis, will not be built.

To determine the size, weight, and grade of pipe to be used, and spacing and size of compressor stations, some tools to work with are needed. These are:

1. Pipeline flow equation.
2. Design pressure equation.
3. Line pipe specifications.
4. Equivalent length equations.
5. Curves or equations to determine horsepower requirements.

There are several different pipeline flow equations, two of the most popular being Weymouth's and Panhandle's. The Panhandle equation is widely used in the industry on problems involving pressures over 500 psig and line sizes larger than 12 in.; whereas, Weymouth's equation is very widely used for smaller lines and lower pressures, and with the addition of a compressibility factor is frequently used at pressures above 500 psig. Our purpose here is to show the use of a pipeline equation, not to discuss the relative merits of any particular equation. For this discussion we will use Weymouth's equation, which is:

$$Q = 433.5 \frac{T_b}{P_b} d^{8/3} \left(\frac{P_1^2 - P_2^2}{G T_r L} \right)^{1/2}$$

where:

- Q = Volume in cubic feet/day at T_b and P_b.
- T_b = Base temperature in °R.
- P_b = Base pressure, psia.
- d = Inside diameter of pipe, inches.
- P_1 = Inlet pressure of section of line, psia.
- P_2 = Outlet pressure of section of line, psia.
- G = Specific gravity of gas (Air = 1.0).
- T_r = Flowing temperature of gas, °R.
- L = Length of section of line, miles.

In order to simplify Weymouth's equation, we can assume some standard values as follows:

$T_b = 60° F = 520° R$

$P_b = 14.65$ psia

$G = 0.6$

$T_f = 60° F = 520° R$

Substituting these values in Weymouth's equation it becomes:

$$Q = 0.871\ d^{8/3} \left(\frac{P_1^2 - P_2^2}{L} \right)^{1/2} \quad (1)$$

where,

Q = Volume in Mcf/day at 14.65 psia and 60° F.

Then by letting $C = 0.871\ d^{8/3}$, we have

$$Q = C \left(\frac{P_1^2 - P_2^2}{L} \right)^{1/2} \quad (2)$$

$$P_1^2 = P_2^2 + \left(\frac{Q}{C} \right)^2 L \quad (3)$$

$$P_2^2 = P_1^2 - \left(\frac{Q}{C} \right)^2 L \quad (4)$$

$$L = \left(P_1^2 - P_2^2 \right) \left(\frac{C}{Q} \right)^2 \quad (5)$$

$$C = Q \left(\frac{L}{P_1^2 - P_2^2} \right)^{1/2} \quad (6)$$

If different values of T_b, P_b, G, or T_f are to be used, this can be readily done by applying appropriate conversion factors to 0.871. For instance, for $T_b = 60°$ F, $P_b = 14.73$, $G = 0.71$, and $T_f = 70°$ F, we have:

$$0.871 \times \frac{520}{520} \times \frac{14.65}{14.73} \times \left(\frac{0.6}{0.71} \right)^{1/2} \times \left(\frac{520}{530} \right)^{1/2} = 0.786$$

For those conditions, C would be $= 0.786\ d^{8/3}$.

If we have any 4 of the 5 unknowns, we can by using Equations (2) through (6) calculate the unknown as follows:

Example 1: Find the volume that can be delivered by a 10.312-in. ID, 100-mile line, operating at 500 psia inlet pressure and 150 psia outlet pressure.

Using Equation (2)

$$Q = 438.8 \left(\frac{250{,}000 - 22{,}500}{100} \right)^{1/2} = 20{,}900 \text{ Mcf/D}$$

Example 2: Find the inlet pressure required to deliver 20,900 Mcf/D, through 100 miles of 10.312-in. ID line with 150 psia outlet pressure.

Using Equation (3)

$$P_1^2 = 22{,}500 + \left(\frac{20{,}900}{438.8} \right)^2 100 = 250{,}000$$

$$P_1 = 500 \text{ psia}$$

Example 3: Find the size line required to deliver 20,900 Mcf/D, 100 miles, when inlet pressure is 500 psia and outlet pressure is 150 psia.

Using Equation (6)

$$C = 20{,}900 \left(\frac{100}{250{,}000 - 22{,}500} \right)^{1/2} = 438.8$$

$$438.8 = 0.871\ d^{8/3}$$

$$d = 10.312 \text{ in.}$$

This kind represents the simplest type of problem encountered, but even these require the use of a design pressure equation to insure that the pipe selected from results of the calculations (as shown in *Example 3*) will do the job safely. The pressure piping code provides that the design pressure for steel piping in a gas system or the nominal wall thickness for a given design pressure shall be determined by the following formula: (841.1 - of ASA B 31.1.8 - 1955)

$$P = \frac{2St}{D} \times F \times E \times T \quad (7)$$

where,

P = Design pressure, psig.

S = Specified minimum yield strength of the pipe, psi.

D = Nominal outside diameter of pipe, inches.

t = Nominal wall thickness, inches.

F = Construction type design factor.

E = Longitudinal joint factor.

T = Temperature derating factor.

The code further provides that:

P for butt-welded pipe shall not exceed 60% of mill test pressure or P as calculated above, whichever is lesser; and

P for all other pipe shall not exceed 85% of mill test pressure or under certain conditions 85% of pressure used for mill-type hydrostatic pressure test, or P as calculated above, whichever is lesser. (841.14 (a) and (b) B 31.1.8 - 1955)

S, D and t will be found in line pipe specifications, the most commonly used of which are those issued by the American Petroleum Institute, of which API Std-5L covers standard line pipe and API Std-5LX covers high-test line pipe.

F varies from 0.4 to 0.72, depending on location, being 0.72 for most cross-country pipelines. (Tables 841.11 - B 31.1.8 - 1955)

E varies from 0.6 to 1.00, depending on type of pipe and specifications under which it is manufactured: 0.6 for butt-welded; 0.8 for lap-welded; and 1.0 for all other API-5L and all 5LX pipe. (Table 841.12 - B31.1.8 - 1955)

T varies from 0.867 to 1.0, depending on operating temperatures. For 250° F or less, it is 1.0. (Table 841.13 B 31.1.8 - 1955)

From *Table 6* of API Std-5L, we find that 10.312-in. ID pipe is 10.750-in. OD with 0.219-in. wall, and the minimum test pressure for lap-welded or Grade A is 750 psig and for Grade B is 850 psig. From *Table 3* we find minimum yield strengths as follows:

Lap-welded or butt-welded—25,000 to 30,000 psi (depending on type steel).

Grade A—30,000 psi.

Grade B—35,000 psi.

Substituting in Equation (7)

$$P = \frac{2 \times 25{,}000 \times 0.219}{10.75} \times 0.72 \times 0.60 \times 1.00 = 440 \text{ psig}$$

So, butt-welded pipe would not qualify under the code, but E for lap-welded is 0.80; so,

$$P = 440 \times \frac{0.80}{0.60} = 587 \text{ psig by equation (7) and}$$

$P = 85\%$ of $750 = 637$ psig by 841.14 (b).

Thus any 0.219-in. wall 10.750-in. API line pipe, except butt-welded, could be used.

This article is adapted from a paper presented by Jim Asbury of Kansas-Nebraska at the 1955 Natural Gas Pipe Line Institute held at University of Kansas, Liberal.

A further check into sizes available shows the 10.750-in. OD, 0.188-in. wall pipe, Grade A pipe would be suitable. Since this pipe is 3.45 lb/ft lighter than 0.219-in. wall 10.750-in. pipe, its use would save 9.1 tons/mile. With pipe costs approaching $160/ton, this would save $1450/mile or $145,000 on a 100-mile line. However, since 0.188-in. wall 10.750-in. OD is a special size, it might not be readily available or might cost more per ton. These points would have to be investigated before the final decision could be made.

All pipe sizes and weights selected should be checked out similarly to assure compliance with the code and to determine the most economical sizes.

Pipelines are usually composed of several sections of different sizes and lengths of pipe in series and frequently some of the sections will consist of two or more lines of the same or different sizes in parallel.

With two different size lines in series it is very convenient to use equivalent lengths. The equivalent length is the length (L_e) of diameter (d_e) that will carry the same volume under the same conditions as length (L_1) of some other diameters (d_1). In Weymouth's equation,

$$L_e = L_1 \left(\frac{d_e}{d_1}\right)^{16/3} \qquad (8)$$

Thus, if we had a line composed of 50 miles of 10.312-in. ID and 50 miles of 8.249-in. ID, its equivalent length in terms of 10-in. is:

$$L_{10} = 50\left(\frac{10.312}{8.249}\right)^{16/3} + 50 = 214.5$$

and in terms of 8-in. is:

$$L_8 = 50\left(\frac{8.249}{10.312}\right)^{16/3} + 50 = 65.2$$

This concept is useful when the problem is to determine how much gas can be delivered through 50 miles of 10.312-in. ID line and 50 miles of 8.249-in. ID line with 500 psia inlet pressure and 150 psia outlet pressure.

Using Equation (2)

$$Q = C\left(\frac{P_1^2 - P_2^2}{L}\right)^{1/2}$$

Now, for a problem involving the use of a compressor station: We have previously found that 20.9 MMcf can be delivered 100 miles using 10.312-in. ID pipe with 500 psia inlet pressure and 150 psia outlet pressure; so let's check into using 8.249-in. ID pipe.

Economic studies have shown that for high load factor lines, the most economic spacing of compressor stations is that which will result in operation at compression ratios (discharge pressure, psia/suction pressure, psia) in the 1.3 to 1.5 range. All compressor stations have some loss in the suction and discharge piping. This drop varies with yard piping design and is another factor that is a matter of economics, but losses of 10 psig in and 5 psig out are reasonable values to assume.

Since the delivery pressure is fixed, we can start at the outlet of the system and work back to determine where a station would have to be located so that 500 psia station discharge pressure would result in 150 psia outlet pressure.

S. D. Ford

James Asbury

Mr. Ford, chief engineer of Kansas-Nebraska, has been with the company since 1951. Following his graduation from the University of Texas with a B.S. in petroleum engineering in 1939, Mr. Ford joined the Republic Natural Gas Co., working in the Hugoton field. He spent the years from 1946-1951 with Stanolind Oil & Gas Co.

A graduate of the University of Illinois with a B.S. in civil engineering, James Asbury is senior engineer with Kansas-Nebraska, where he has been since 1950. His duties consist mainly of pipeline design and construction layouts and details.

★

We do not have a known C or L for the combination line, but we can calculate the equivalent L and use the corresponding C. Thus,

In terms of 8-in. equivalent $L_8 = 65.2$ and $C = 242.0$; so

$$Q = 242.0\left(\frac{250{,}000 - 22{,}500}{65.2}\right)^{1/2} = 14{,}300 \text{ Mcf}$$

In terms of 10-in. equivalent $L_{10} = 214.5$ and $C = 438.8$; so

$$Q = 438.8\left(\frac{250{,}000 - 22{,}500}{214.5}\right)^{1/2} = 14{,}300 \text{ Mcf}$$

It is likewise convenient to convert parallel lines into equivalent lengths. In Weymouth's equation the equivalent length (L_e) of diameter (d_e) of two or more lines in parallel is found by:

$$\frac{(d_e)^{8/3}}{(L_e)^{1/2}} = \frac{(d_1)^{8/3}}{(L_1)^{1/2}} + \frac{(d_2)^{8/3}}{(L_2)^{1/2}} + \cdots \frac{(d_n)^{8/3}}{(L_n)^{1/2}} \qquad (9)$$

Thus, if our problem is to find the volume that can be delivered by 50 miles of 10.312-in. ID line in series with two 50-mile sections of 8.249-in. ID lines with 500 psia inlet and 150 psia outlet pressures, we use equation (2), but again resort to equivalent lengths, as follows:

In terms of 10.312-in. line, two 8.249-in. ID lines 50 miles long are:

$$\frac{(10.312)^{8/3}}{(L_e)^{1/2}} = \frac{(8.249)^{8/3}}{(50)^{1/2}} + \frac{(8.249)^{8/3}}{(50)^{1/2}}$$

$$\therefore \quad L_e = \left(\frac{10.312^{8/3}}{2\left(\frac{8.249^{8/3}}{50^{1/2}}\right)}\right)^2 = 42$$

So, in terms of 10.312-in. ID, equivalent length of the system is 42 + 50 = 92 miles and,

$$Q = 438.8\left(\frac{250{,}000 - 22{,}500}{92}\right)^{1/2} = 21{,}850 \text{ Mcf}$$

Pipeline design... Horsepower requirements are usually determined from standard curves

Using equation (5)

$$L = \left(P_1^2 - P_2^2\right)\left(\frac{C}{Q}\right)^2$$

$$L_1 = (250{,}000 - 22{,}500)\left(\frac{242}{20{,}900}\right)^2 = 30.5 \text{ miles}$$

To obtain a station discharge pressure of 500 psia, with 5 psig drop in the discharge piping, the compressors would have 505 psia discharge pressure. Assuming a compression ratio (C_R) of 1.5, the suction pressure would be 505/1.5 — 337 psia, and with 10 psig drop in inlet piping, the outlet pressure of the pipeline would be 347 psia. Using 347 psia outlet pressure we can calculate L to the next station.

However, before we can do this, we must determine the horsepower requirements at the station so we can determine our fuel requirements. The fuel requirements are important, because this gas must be brought to the station by the pipeline, so Q for all preceding sections will be increased.

Horsepower requirements are usually determined from standard curves, since this is much faster than by calculation. Compressor engine manufacturers supply such curves and numerous handbooks contain them. One convenient source is the Natural Gasoline Supply Men's Association Engineering Data Book.* To use these curves, the ration of specific heats ($C_p/C_v = n$) must be known. If an analysis of the gas is available, this can be calculated; but if not, it can be closely approximated from the specific gravity by using a curve with "n" values plotted against specific gravity.** For 0.6 gravity, n = 1.28, and for $C_R = 1.5$ and n = 1.28, horsepower required/MMcf = 28.8. Thus, to compress 20.9 MMcf/d from 337 psia to 505 psia requires 600 hp.

Compressor engines come in standard sizes, so manufacturers' catalogs should be consulted to find the most appropriate size. Compressor auxiliaries such as lube oil pumps, jacket water pumps, etc., require horsepower and 10% is usually added to cover these requirements. (On larger projects these requirements are usually calculated more precisely.) Six hundred and sixty hp is a fairly standard size unit, so one could be used. However, to reduce capacity loss due to compressor failure in stations without standby units and to reduce cost of spares, units are usually selected of such size that at least two units are installed at each station. Thus, two 330's (another fairly standard size) could be installed and if desired these could be spared with one 330-hp unit.

Fuel requirements for 660 hp @ 10 cf/hp-hr would be 144 Mcf/day (use 150 Mcf). Adding this to the 20.9 MMcf out of the station, the inlet volume would be 21,050 Mcf. Then,

*1953 printing of 6th edition, pp 28-31 incl.

**pp 23-25 incl. NGSMA Data Bk. - 6th Ed.

$$L_2 = (250{,}000 - 121{,}000)\frac{242}{21{,}050}^2 = 17.0$$

$L_1 + L_2 = 47.5$ miles; so the gas has 52.5 miles left to travel. At the next station another 150 Mcf/day would be added for fuel and the result would be:

$$L_3 = (250{,}000 - 121{,}000)\frac{242}{21{,}200}^2 = 16.8$$

Now, $L_1 + L_2 + L_3 = 64.3$ miles, and at the next station another 150 Mcf of fuel must be added; so,

$$L_4 = (250{,}000 - 121{,}000)\frac{242}{21{,}350}^2 = 16.6$$

Now, $L_1 + L_2 + L_3 + L_4 = 80.9$ miles and another 150 Mcf must be added for fuel; so,

$$L_5 = (250{,}000 - 121{,}000)\frac{242}{21{,}500}^2 = 16.3$$

However, with a 100-mile line, 19.1 miles remain; so stations would be relocated slightly to accomplish relatively uniform loading and, if necessary, horsepower installed would be adjusted to meet requirements.

In actual practice, the above calculations would probably have not been completed as such density of compressor stations ordinarily would not be economically feasible. A preliminary look at the economics to determine transportation costs of the two designs will readily show why this is the case. To do this, numerous assumptions must be made to determine initial investment, fixed cost and operating cost. The values used herein are representative, but are used only to show the method, not to indicate the costs for any particular company.

In actual practice, detailed studies for a particular company are required to determine these costs, and in most cases a more detailed analysis of comparitive costs will be required before final selection of a design can be made. The method used here is usually adequate to select a design or designs which are worthy of more detailed studies.

TABLE 1. TRANSPORTATION COSTS FOR TWO DESIGNS

	A 100 Miles 10-in. No Station	B 100 Miles 8-in. 4-660-hp Stations
Investment	$2,500,000	$2,660,000
Annual fixed costs	319,000	339,000
Annual operating costs:		
Pipeline	25,000	20,000
Compressor	.....	79,200
Annual transportation costs	$ 344,000	$ 438,200
Transportation costs cents/Mcf	4.51	5.75

Investment costs for pipelines include the cost of line pipe, coating, ditching, laying, backfilling, right-of-way, damages, engineering, inspection, communications, overhead, and contingencies. Investment costs for compressor stations include cost of compressor, auxiliary equipment, employee housing, station piping, buildings, station site, communications, inspection, overhead, and contingencies.

Fixed costs are determined by investment and are usually expressed in percent of investment. These include property taxes, depreciation, insurance, and return on investment.

Operating costs include labor, fuel, maintenance, supplies, lubricating oil, and operating overhead. These can be easily expressed in $/inch-mile of line and $/hp. Representative figures are:

Investment:

Pipelines	$2500/inch-mile
Compressors	$250/hp

Annual fixed costs:

Property taxes	1.25%
Depreciation	4.00%
Insurance	0.50%
Return	7.00%
Total fixed cost	12.75%

Annual operating costs:

Pipelines	$25/in-mile
Compressors	$30/hp

From the above, we can compare the transporation cost for the two designs (see *Table 1*).

Thus, we see that use of 10-in pipe without compressors, instead of 8-in. pipe with compressors, results in a saving of 1.24 cents/Mcf transported. Most designs considered do not have this much variation and usually, in selecting a final design, other factors have to be considered, particularly possible increased loads.

A quick look at another problem will show this.

Problem: Design a pipeline to transport 50 MMcf/day, 100 miles, with 500 psia inlet pressure and 150 psia outlet pressure.

Using equation (6) we find the required C= 1048, which would be C for 14.25-in. ID pipe. A check of the API Std-5L shows no such pipe; so we must use the next largest standard size to avoid the high cost of special rolling. This will be 16-in. OD, 15.376-in. ID for which C = 1273. (5L also lists some lighter weights of 16-in. as speial sizes and they would be checked to see if available, as previously mentioned for the 10-in.) Since the capacity of pipelines vary directly as C, the 16-in. line could transport 60.8 MMcf/d, so we should investigate equivalent lengths. Fourteen-inch pipe is not a very widely used size for gas lines today, so we would consider 16-in. and 12-in.

By equation (8) 100 miles of 15.376-in. ID is equivalent to 149 miles of 14.25-in. ID. So we need a combination of 16-in. plus 12-in., which will be equivalent to 149 miles of 14-in.

TABLE 2. TRANSPORTATION COSTS FOR THREE DESIGNS

	A 100 Miles 16-in. No Stations	B 79.2 Miles 16-in. 20.8 Miles 12-in. No Stations	C 44.9 Miles 16-in. 55.1 Miles 12-in. 1-1600-hp Station
Investment	$4,000,000	$3,774,000	$3,849,000
Annual fixed costs	511,000	482,000	492,000
Annual operating costs:			
Pipeline	40,000	37,700	34,500
Compressors	.....	.....	48,000
Annual transportation costs	$ 551,000	$ 519,700	$ 574,500
Transportation costs cents/Mcf	3.02	2.85	3.15

therefore:

$$L_{16} + L_s = 149$$
$$L_{16} + L_{12} = 100$$
$$L_s - L_{12} = 49$$

substituting $L_{12}\left(\frac{15.376}{12.250}\right)^{16/3}$ for L_s,

we have $3.36\ L_{12} - L_{12} = 49$

$$L_{12} = 20.8$$

Therefore, 79.2 miles of 15.376-in. ID and 20.8 miles of 12.25-in. ID pipe will handle the 50 MMcf/d.

By using 100 miles of 12.25-in. ID pipe, compressors will be required. Again we can start at the outlet of the line to calculate required location of the first station. Using equation (5), the first station would be needed 44 miles from end of the line. Fourteen hundred and forty horsepower would be required, so 1600 would probably be installed. Fuel requirements would be 400 Mcf. The next station would be 24.5 miles upstream. Since this is too close, we will then calculate a line size which will let us use only one station. Thus, we need a line sized to have 500 psia inlet, 347 psia outlet and transport 50.4 MMcf/d a distance of 56 miles.

Using equation (6) we find the required C — 1050 or 14.25-in. ID; so we solve for equivalent 16- and 12-in. and get 11.1 miles of 12-in. and 44.9 miles of 16-in.

Now, we have three designs for which to determine transportation costs (see *Table 2*).

At first glance it appears that Design B would be best, but if you consider that Design A actually has a capacity of 60.8 MMcf and assume it operating at 100% load factor, as B and C are assumed to do, its costs/Mcf become 2.48 cent/Mcf. Thus, Design A should be given preference, particularly if there is any likelihood of needing to increase the line capacity.

To point this up further, checking Designs A, B and C to determine their respective transportation costs at 100 MMcf/d rates, it will be found that design A's advantage will be even greater.

This comparison of what happens to transportation costs in a pipeline that is just barely big enough originally, emphasizes the wisdom of being as sure as economics will possibly allow, that the line is amply large initially. Even if the possibility of future expansion looks very remote, generally speaking, the best design is the one with the greatest flexibility and possibility for economical expansion, everything else being anywhere near equal. ■

GASOLINE PLANTS

GAS exclusive

How they operate and their importance to distribution companies

Are gasoline plants of importance to natural gas distribution company people? Yes, they strip components from the gas that would choke up burner tips and otherwise reduce the efficiency of gas as a fuel. Here, in non-technical terms, is a description of what goes on at a gasoline plant.

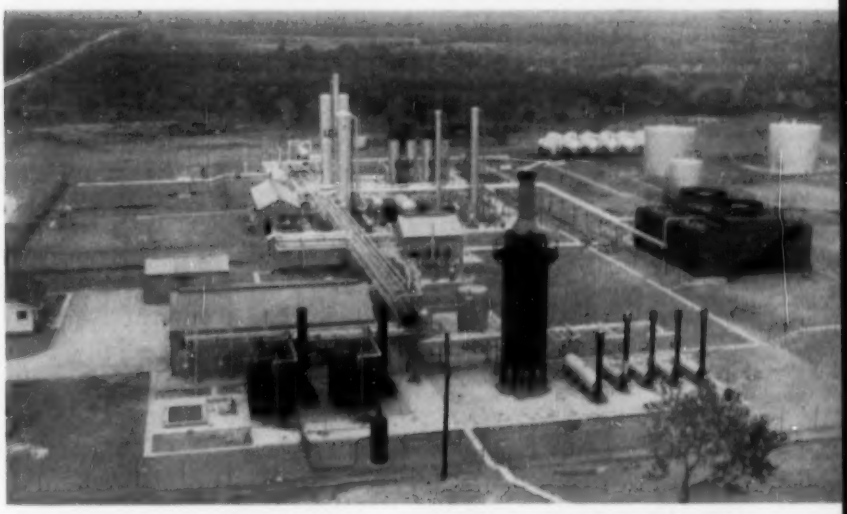


Fig. 1. Aerial view of United Gas Pipe Line Co.'s Cabeza Creek gasoline plant located near Runge, Karnes county, Texas. This plant processes about 100 MMcf of natural gas per day for a recovery of 71,000 gal. of LPG products and debutanized gasoline.

By A. H. WEIL, General Superintendent, Gasoline Department
United Gas Pipe Line Co., Shreveport, La.

NATURAL gas comes easily, readily to the residential, commercial and industrial user. The flick of a tiny wheel on a thermostat, the slight turn of a knob, the click of an automatic control and natural gas goes to work—to heat, to cool, to create energy that turns the wheels of industry, to help manufacture products and materials, to make direct contribution in many ways to the comfort, convenience and modern living of many millions of American families.

Natural gas, indeed, is the world's most versatile fuel as well as a fabulous raw material subject to conversion and processing from which comes an almost endless chain of miracle items for the channels of trade and commerce.

It is understandable that dependable and effortless natural gas service, so far as the consumer is concerned, may have built up an erroneous impression in the public mind as to the work, investment and know-how that are required in all elements of the natural gas business to provide the kind of around-the-clock service to which customers are accustomed. Even the specialized distribution segment of the industry itself may not be fully cognizant of all the "steps" through which natural gas passes in its movement from the well, through pipeline systems to the local distributor far removed from areas of production, and finally on to the ultimate customer. One of these steps is in the gasoline plant, where natural gasoline and other hydrocarbons are "recovered," and the dehy-

Gasoline Plants... The terms "wet gas" and "dry gas" pertain to the hydrocarbon content

dration plant where water vapor is removed from natural gas.

For these purposes, then, it is quite logical that we "take a look" at the gasoline plant and dehydration plant operations of United Gas, largest handler of natural gas in the world.

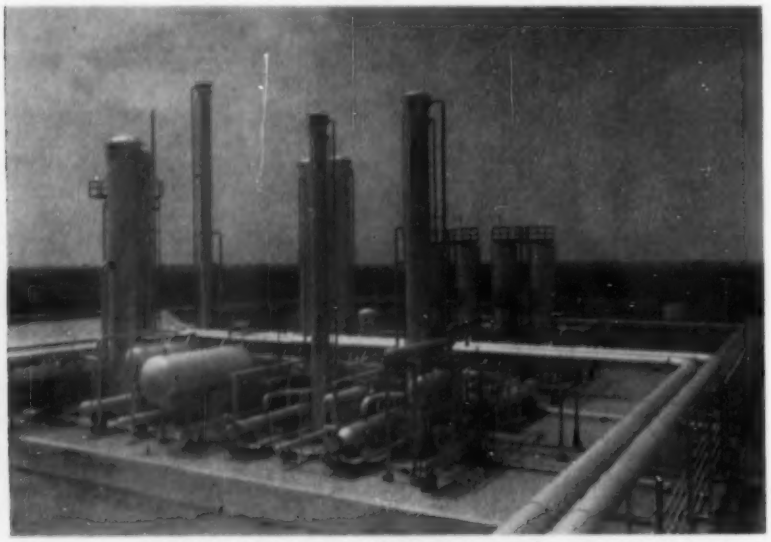


Fig. 2. Closer view of the process area. Fractionation and absorption towers are in the foreground. Four towers immediately in rear are dehydration units.

United Gas Pipe Line Company operates seven gasoline plants. The largest is located in the Carthage field in Panola County, Texas. Other plants are located at Karnes City, Agua Dulce and Cabeza Creek, Texas, the latter plant going into service the early part of this year. Three plants are located in north Louisiana at Myrtis, Koran and Sugar Creek. The pipeline company also owns and operates 28 dehydration plants.

Since the objectives and operations of all of the gasoline plants are virtually the same, it will be desirable to present a general background on such plants, followed up by more detailed information on the company's newest plant at Cabeza Creek, Texas (see Fig. 1).

Approximately 12% of the natural gas handled by United passes through company-owned and operated gasoline plants in advance of entering the pipeline, and some 40% of the natural gas goes through the company's dehydration plants. Both types of plants require large investments in facilities to accomplish their respective purposes. Although there are other important reasons for putting natural gas through a gasoline plant or a dehydration plant, one of the principal reasons is that each of the processes makes a direct contribution to improving the quality of natural gas delivered to the ultimate consumer.

All natural gas produced falls into two general categories: it is either (1) "wet gas " or (2) "dry gas." The two terms have nothing to do with the production of water in conjunction with the gas, but are descriptive of the hydrocarbon content of the gas. "Wet gas" is the term used to describe natural gas which contains relatively large percentages of compounds higher in molecular weight than propane. Some natural gas production, of course, is "dry," and after the removal of water that may be produced with it, is moved directly into the pipeline system.

"Wet gas" on the other hand is processed to produce dry natural gas and raw natural gasoline. Additional processing of raw natural gasoline results in the recovery of lighter hydrocarbons, such as butane, propane and others, which are generally known as liquefied petroleum gas (LPG) which is so widely used today.

The gasoline plant procedure actually is a "recovery" operation in which additional products of sufficient value are secured to warrant the expense of constructing and operating such a plant. The recovery of various hydrocarbons from natural gas also is an important step in the conservation of valuable constituents such as motor fuel, natural gasoline, kerosene, liquefied petroleum gases, and other products which otherwise would remain in the gas.

It already has been pointed out that one of the factors in "stripping" natural gas of hydrocarbons is to improve the quality of the product delivered to customers. Natural gas, when not processed contains any considerable amount of hydrocarbons, has a tendency to choke up burner tips and clog pipelines, and decreases the efficiency of gas as a fuel by causing serious maintenance and operating problems.

Raw natural gasoline usually contains 10 to 30% of light high-vapor-pressure components. These dissolved gases cause natural gasoline to be highly volatile and they must be removed to stabilize the gasoline before it can be marketed. Stabilization is nothing more than fractionation—physically separating the components by successive operations such as by distillation. The function of the gasoline plant, then, is to effect this separation of the hydrocarbons occuring in "wet" natural gas.

The size of a gasoline plant depends entirely upon the daily volume of production available, and the potential life of the gas field where the plant is located. The capacity of a plant is determined by the number of million cubic feet of gas than can be processed or "run through it" each day. Some natural gas, of course, is "richer" in recoverable hydrocarbons than others. Consequently the amount of gas run through any plant does not furnish the key to its actual output of LPG products.

For example, the gas produced from the Coy City field in Texas is processed by United's Karnes City plant. This is a very rich gas. While the average day's run of gas through the plant is only around 6 MMcf, there is a high ratio of recovery of approximately 4000 gallons of products per MMcf.

The company's new Cabeza plant is designed to process 100 MMcf of gas per day with a recovery of approximately 71,000 gallons of LPG products and debutanized gasoline.

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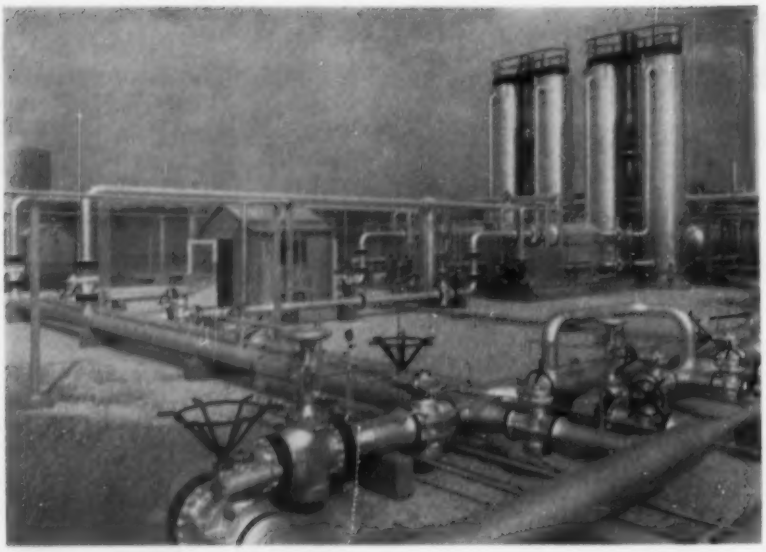

Fig. 3. Outlet piping and meters are shown in the foreground. The dehydration plant is seen in the background. United Gas operates seven gasoline extraction plants within its huge natural gas pipeline network.

Technical direction of United's gasoline plants is the responsibility of the gasoline department in the general office at Shreveport. Numerous fiscal and sales records are maintained at the respective pipeline company district offices, according to the geographical location of the plant. A plant superintendent, or foreman in the case of smaller plants, is the resident manager in charge of day-by-day plant operations. All gasoline plants operate on a 24-hour basis.

Operational procedures and methods of all of United's gasoline plants are virtually the same, so a description of the operation of the new Cabeza Creek plant will provide a background on how all are operated.

The Cabeza Creek Gasoline and Dehydration plant processes natural gas produced from 26 fields in what is known as the Cabeza Creek and Hordes Creek areas in Goliad, Karnes and De Witt counties, Texas. United's original Cabeza Creek gathering system was constructed in 1949 to transport gas purchased from approximately 25 wells in the area. Today there are more than 120 wells connected to some 78 miles of company pipelines that spread out into the field areas.

The process involved in removing the hydrocarbons is called absorption, and the absorbent that is used is known as "lean oil." Here — in non-technical terms—is how the process works.

The natural gas enters the plant at the bottom of a large absorber and rises upward to the top, while the "lean oil" (which has an affinity for gasoline hydrocarbons) enters the vessel at the top and flows downward to the bottom. In this process the gas passes through the oil, which absorbs most of the liquefiable hydrocarbons in the gas. What happens, then, is that the wet gas enters at the bottom of the absorber and passes out at the top as dry gas, while the lean oil enters the absorber at the top and passes out at the bottom as rich oil. The operating pressure of the absorption tower is set at approximately 750 psig with all of the equipment capable of going to 1000 psig operating pressure if required *(Fig. 2)*.

Thus, there is a column of oil gradually getting richer and richer in absorbed gasoline hydrocarbons, and a column of natural gas gradually getting dryer and dryer with respect to gasoline hydrocarbon content. The dry gas next moves through the dehydration plant for the removal of moisture and then leaves the plant through a 16-in. line. This line extends approximately 6 miles to tie in with United's 16-in. Pettus-Converse line and some 2½ miles farther west to join the 20-in. Burnell-Converse line. A large portion of the gas ordinarily flows north into the San Autonio and Austin areas.

After the hydrocarbons are absorbed in the oil—and this is a continuous process—the next step is to remove the hydrocarbons from the absorption oil. The absorption oil has a boiling point much higher than that for the gasoline hydrocarbons. Therefore, it is a comparatively simple operation to remove gasoline by distillation. (See *Fig. 4.*)

The Cabeza Creek plant turns out two products—(1) liquefied petroleum gas products, and (2) debutanized gasoline. Since liquefied petroleum gases vaporize rapidly at atmospheric pressure, they must be kept and handled under pressure at all times. The LPG products are sold to LPG marketers and the debutanized gasoline goes to a Bee county refinery for further processing.

As already pointed out, United Gas operates 28 dehydration plants, and the units at Cabeza Creek are similar in operation and construction to all such company plants constructed in recent years. The dehydration plant is an operation for the removal of water vapor from natural gas. The process does not involve a chemical change in the gas passing through the dehydration cycle.

United built its first dehydration plant in 1940. In recent years, with the rapid increase in pipeline transmission of large quantities of natural gas to meet customer demands, there has been a parallel rise in the number of dehydration plants built and operated by the company. The increased pressures now used in pipelines transporting natural gas, and operational difficulties caused by corrosion and by hydrate formations in the lines as a result of moisture in the gas, have combined to make it necessary that the industry give more attention to the moisture content of the fuel. Another factor contributing to the necessity for removing water vapor from gas has been the extension of transportation lines to colder climates. Since natural gas hydrates form at temperatures in some cases considerably above 32° F, it is obvious that the water vapor content of gas must be kept at a low level to prevent formation of hydrates in the lines and subsequent interruption of service.

All dehydration plants constructed by United Gas Pipe Line Company since 1950 have been of the adsorption type due to the ability of the adsorption process to remove water vapor content from natural gas with greater efficiency. The adsorption process uses a solid type of desiccant.

Each solid-desiccant type of dehydration unit consists of a minimum of two adsorption towers, which are required to maintain a continuous operation. Hydrocarbon liquids, as we have seen, are removed from the gas in advance of moving it into the adsorption tower.

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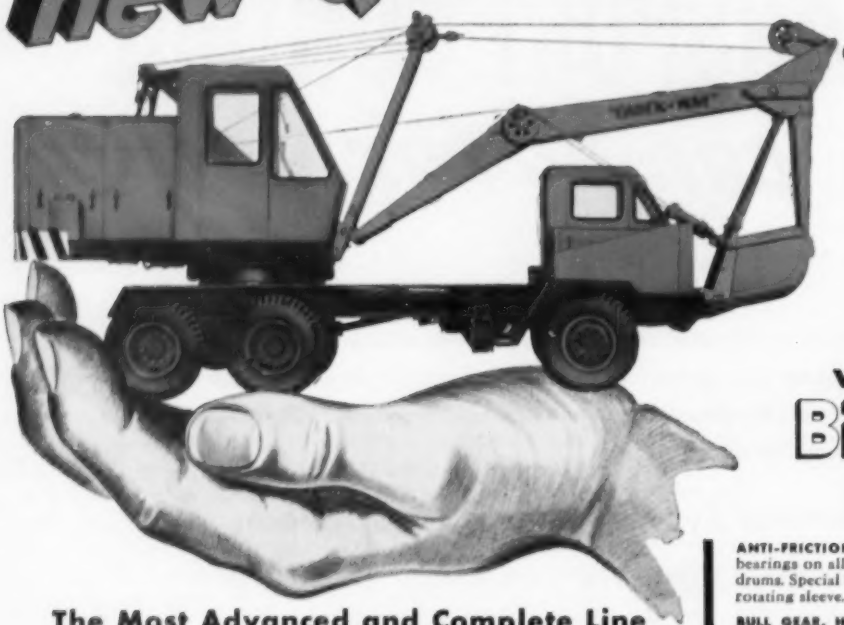

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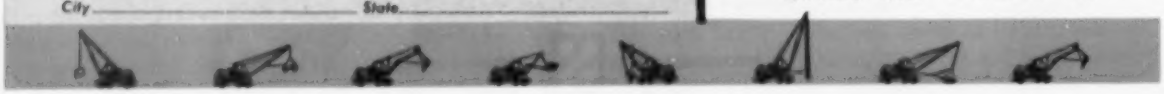

The adsorption towers contain a quantity of either bauxite or silica desiccant material, which adsorbs the water from the gas. The adsorption process is worked out on a time basis, and when the first phase of the cycle is completed, the gas stream is turned into the second tower. During the period while the desiccant material is doing its adsorption job in one tower, water is being eliminated from the other. This is accomplished through a process of passing heated gas through the water-saturated adsorber, desorbing the water from the desiccant. This hot gas is then cooled and returned to the main gas stream so that no gas is lost or vented. From 8 to 12 hours are required for a complete cycle *(see Fig. 3)*.

Dehydration plants are so constructed that the cyclic operation is practically automatic. Minimum personnel is employed to maintain and operate the plants.

United Gas Pipe Line Co., along with most other major pipe line companies, specifies the maximum permissible water vapor content in the gas the company handles and sells at 7 lb per MMcf. A water vapor content usually below that level is sought at all times. The importance of meeting the required specification as to water vapor content of natural gas under high pressure is such that United maintains a number of automatic dew-point recording devices at dehydration plants and along the pipeline system. These automatic recording devices help to insure that the gas being transported and delivered to customers of the company meets the proper water-content specification at all times.

United Gas personnel at the Cabeza Creek gasoline and dehydration plant numbers 18. Some of the employees live in company-owned residences constructed at the plant site.

In addition to the main gasoline and dehydration plant units, the Cabeza Creek installation has the equivalent of approximately 760,000 gallons of products storage capacity. Two 5000-barrel tanks and one 1000-barrel tank are used to store de-butanized gasoline. Six 1200-barrel horizontal storage vessels are used for LPG products. In addition, another 18,000-gal. tank stores the absorbing oil which is used to separate the hydrocarbons from the natural gas in the absorber towers.

Other structures at the plant include a process pump building *(Fig. 5)*, auxiliary building, recompressor building, shop and change building, meter building, fire cart building, product loading dock, office and laboratory, and dehydration building.

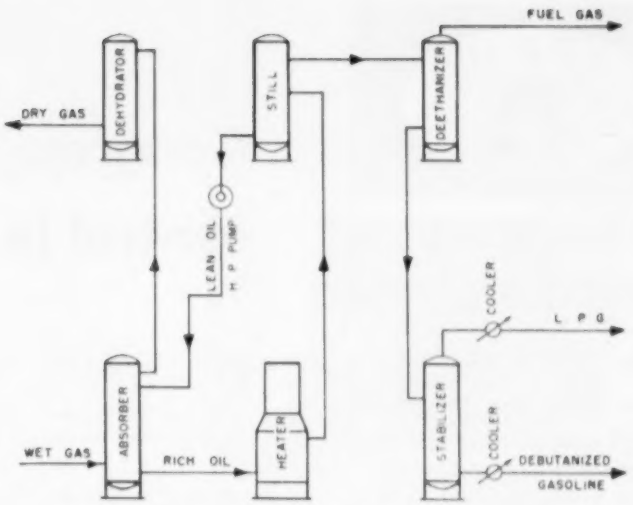

Fig. 4. Simplified flow diagram, Cabeza Creek gasoline plant.

The quality of products produced at Cabeza Creek—as well as at other United plants—must be held to rigid specifications. Consequently there is a continuing sampling and testing of each product to be certain that it meets the desired specifications. Each gasoline plant is equipped with a product-control laboratory where the testing work is done.

United Gas does not sell any of its gasoline plant products directly to the retail consumer. Marketing is done by contract with marketers, or to manufacturers who use the various products in other manufacturing processes.

The extensive gasoline and dehydration plant operations carried out by United Gas Pipe Line Co. are examples of the know-how, specialized techniques and large investments that are required throughout all phases of an integrated natural gas operation to provide dependable service and to deliver high quality, efficient natural gas to the burner tips of all types of customers. ■

Fig. 5. Interior view of the process pump house at United Gas' Cabeza Creek gasoline plant.

WASHINGTON

Congress airs kind of control in gas bill debate

By HUBERT KELLEY

This Washington report was written just as GAS was going to press. No final word was yet available on the status of the Harris-Fulbright bill.

AS Senate debators continued their battle over the Fulbright-Harris natural gas bill, it was clear that whether the measure passed or failed, it would be only after a long debate.

In the early days of the floor fight, Sen. J. W. Fulbright (D.-Ark.) clearly stated the question before the Senate. The problem, he said, was not one of control vs. decontrol, although a number of producers would prefer the latter. It was not a question of regulation vs. no regulation at all. It was simply a matter of what *kind* of control to apply to the producers of natural gas.

By a 5-to-3 decision in June 1954, the Supreme Court ruled that thousands of gas producers were public utilities whose rates should be regulated by the FPC.

Bill's extent

The Fulbright-Harris bill, on the other hand, was written to exempt producers from this utility-type regulation and instead authorized FPC to prevent pipeline companies from paying producers more than a "reasonable market price" for their gas.

For the producers, the Fulbright-Harris bill represented a tremendous improvement over direct FPC rate control. But it was not a final answer to producer objectives. In a recent letter to the New York PSC, Maston Nixon, chairman of the General Gas Committee, wrote: "I am quite frank to say that I and most producers do not feel that any regulation whatsoever is necessary."

But as the congressional showdown arrived, Nixon admitted, the Fulbright-Harris bill was the only relief in sight.

Unless the bill passed, gas producers would be regulated as public utilities. There was little question, granted Senator Fulbright during the Senate debate, that interstate pipelines and local distributors are utilities in every sense of the word. They are utilities, he said, because they enjoy government-granted advantages which are tantamount to a legal monopoly. He added that their accounting practices are generally uniform and their costs can be told with accuracy.

Different situation

But in the case of the producer, the senator continued, "the situation is completely different. No government agency shields him from competition. He must compete with thousands of other producers for leases before he can drill a single well. Should he be lucky and hit that one-to-nine shot, he must compete with many other producers for a market. No one guarantees him a return on his invested capital, thus eliminating the tremendous risks he must take. His is inescapably a business of economic imponderables. His costs are almost impossible to ascertain. The producer, in short," Senator Fulbright concluded, "hasn't a single characteristic of a public utility."

What was in sight for producers if the bill failed to pass the Senate?

First of all, claimed spokesmen for the measure, there would be less gas at higher prices. During the first 11 months of 1955, they pointed out, oil well completions in the United States increased 8%. Gas well completions, on the other hand, dropped nearly 9%. As Senator Fulbright put it, "the handwriting has already begun to appear on the wall."

Second, the FPC would mushroom from a fairly large regulatory agency to a giant of central control and power. Before the Supreme Court decision, The commission handled about 1000 cases a year. Since the decision, however, 13,000 applications have been flooded in from producers and gatherers. The annual FPC budget necessary to handle this staggering workload, it has been reliably estimated, might well be around $80 million.

But the problem of FPC's workload would not be one of budget increases alone, according to Sen. A. S. Monroney (D.-Okla.). During the debate, he claimed that it will be five or 10 years before FPC will be able to establish rates for producers, and "some of the gas companies will go bankrupt before that time." Even though the commission granted some increases before the debate began, Senator Monroney said it was doing nothing more than administering "artificial respiration" to the patient.

FPC recommendation

FPC itself recommended passage of the exemption bill, as did President Eisenhower's fuels policy cabinet committee. As far as enforcing the Phillips decision went, Senator Fulbright said the FPC situation was "intolerable."

But the bill's opponents foresaw grave threats if the measure is passed. A Senate committee minority report, signed by Sen. Warren Magnusen and others, warned that consumer protection must start at the source of interstate travel.

"It cannot begin, as proposed by this bill, in the middle of the stream, leav-

Continued on page 130

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Continued from page 128

ing the producer free to charge what he will, while at the same time controlling the price everyone else can charge," the report said. "To urge that such a scheme is fair and equitable and in the consumer interest is sheer hypocrisy." And on the floor, Sen. Paul Douglas (D.-Ill.) guessed that American gas bills might go up $600 million a year if the bill passed.

Senator Fulbright disagreed strenuously, and insisted that his bill would assure consumers of reasonable market prices for their gas through a number of safeguards.

First, the bill sets a ceiling of "a reasonable market price" on the amount that an interstate pipeline company may pay the producer and then pass along to the consumer. In other words, it switched the emphasis from regulating what a producer can *charge* to what a transmission company can *pay*.

This ceiling in the Fulbright-Harris bill would apply to all new and renegotiated contracts entered into after the bill became law, and to certain types of escalation clauses in existing contracts as well. The two exceptions in current controls are:

1. Those designed to compensate the producer for tax increases.

2. Those which provide for periodic step-ups of fixed and definite amounts. During hearings, there was little objection to these types of escalation.

The bill also provided that even if the new standard of "a reasonable market price" prevented producers from receiving their contract prices, they would have to go right ahead delivering the gas at the lower figure for the remainder of the contract period.

If the pipeline company owned some of its own gas sources, the same ceiling of "a reasonable market price" would apply to its prices to distributors. In the debate, Senator Douglas charges that this provision mounted to "a direct inducement" to the pipeline companies to pay more for gas so that they could charge more for the gas they produce themselves.

The Fulbright-Harris bill also requires FPC to consider in advance whether the producer's price is a "reasonable market price" when studying a pipeline company's request to expand its interstate facilities.

Much Senate controversy gathered around the phrase, reasonable market price. Sen. Frederick G. Payne (R.-Maine) argued that this method of fixing transmission company allowances should be discarded, and a "just and reasonable" formula substituted.

But this sort of pricing arrangement, argued Senator Fulbright, would place the whole business back on a cost basis, and costs simply cannot be determined with accuracy for gas wells.

As a practical matter, said Senator Fulbright, "the utility base rate concept cannot be applied in determining the field price of natural gas. This risk-taking competitive business cannot continue under a system that allows a 5 or 6% return on successful ventures and nothing on unsuccessful ventures."

The chairman of the Republican Policy Committee, Sen. Styles Bridges of New Hampshire, saw the utility question in even broader terms. "Backers of direct controls do not know that what they seek is undermining their own liberty," Senator Bridges exclaimed in support of the bill. If the bill failed to pass, he predicted that someday a New Hampsire chicken farmer who sold his friers in Boston might have the price laid down by a Washington poultry commission. ■

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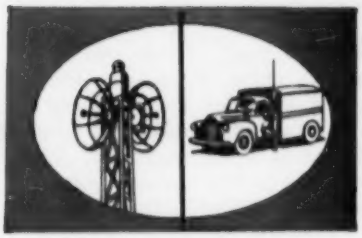


System maintenance of two-way radio

By FRANK CHAPMAN

This article was written by Joseph Jatis, assistant to the national service manager of Motorola Inc., Chicago

THE continuous operation of an efficient, dependable and reliable radio communications system requires regular attention to maintenance. It may be true that some radio communication systems will operate with very little attention; nevertheless, to insure continued good performance of equipment, it is necessary that a program be developed for periodic checking or testing of the entire system.

Any worth while preventive maintenance program must be based on "system maintenance." This means the inspection and maintenance of all the units constituting the complete organized whole, in a systematic and planned orderly fashion.

All radio communications systems include integrated assemblages. A failure in any one of these would constitute a failure of communications. However, there are three major factors in a radio communications system which require attention: (1) the primary power source, (2) The units assemblages, and (3) The antenna system.

Contrary to popular belief, automobile batteries seldom go dead without warning. They usually fail after a long period of undercharging or overcharging, lack of water, poor connections or old age, with many indications of the approaching end. From the radio technician's point of view the voltage available at the battery terminals under load is the telling point. A fully charged lead-acid battery under a given load may show a measured voltage of approximately 6.4 volts in the case of a "6-volt" battery and 12.8 volts in the case of a "12-volt" battery. An old sulfated or undercharged battery may show voltages of only 6 volts or lower. These are battery terminal voltages, not the voltage present at the units. The terminal voltage at the units in the trunk of the car will probably be .5 to .7 volts lower when a transmit current of about 40 to 60 amperes is being drawn.

One of the good methods of checking primary power trouble is to measure battery voltage both at the terminals of the battery and at the equipment. An immediate drop in voltage of more than .2 volts measured at the battery on a short transmit cycle would indicate a battery in poor condition. A drop of more than .7 volts measured at the units would point to troubles in the primary circuit—cable, fuse block, relay or chassis return. This voltage drop is excessive and should be investigated fully.

"A" relay contacts wear out, requiring replacement.

Fuses get tired; sometimes even when new they may have too much resistance. Check and replace if voltage drop exceeds .1 volt.

Connections loosen as a result of vibration. Tighten or resolder.

Fuse Holders also loosen because of vibration. They lose their temper because of heat resulting from poor contact. Acid causes corrosion. Accumulation of oil and dirt increases contact resistance and the remedial action is to clean contacts, tighten or replace.

Keeping voltage drops to a minimum in a primary circuit is very essential to good system operation. The same rules apply to other sources of power. Dry batteries especially must be checked under full load. Some knowledge of the number of hours of use must be available as an indication of when they most likely will need to be replaced.

AC sources of power are by no means free of trouble. Primary voltages are always suspect in AC circuits as they can often be too high as well as too low. In some cases application of voltage regulators may be necessary. Loose connections on fuses occur even in AC circuits. A hot fuse or connection is always a key point for a good maintenance man to investigate.

Primary power sources should be the first check points in preventive maintenance procedures and should be checked periodically.

Unit assemblages include transmitter, receiver, power supply, etc. In maintaining unit assemblies the secret lies in knowing what to do and what to leave along. Very few adjustments need to be made regularly in transmitter and receiver units. To catch a maximum number of incipient troubles, the technician must use his eyes, his ears, his sense of touch, and meter measurements, as well as his good judgment and past experience.

Good test equipment is essential to good system performance. It saves time and enables the serviceman to do a better job.

Basically four types of observation are required. First of all, an experienced technician can often detect warnings of impending trouble by noting the audio quality, the noise background and the squelch operation in relation

to the settings of the volume and squelch controls. He will come to know the normal signal level he should obtain at given locations with selected stations in a particular system. Degradation of performance will be immediately apparent to the technician who checks the set periodically, whereas the steady operator may become accustomed to a gradual degraded performance.

Secondly, look for loose bolts, screws and clamps, worn michophone cords, burned out pilot lights, arcing at any point, loose or broken components, burned resistors, or loose connections. A good visual inspection not only is a means of quickly locating the source of trouble, but may prevent more serious trouble from developing later.

Primary power sources are the first check points in preventive maintenance procedures.

The fingers are good detectors of improper temperature conditions. Fuses, fuse holders, crystal ovens, transformers and relay coils which are too hot mean trouble. Also a cold crystal oven, tube or resistor that should normally be warm is probably in trouble. Such tests are quick and should be used often.

Finally, actual quantitive measurements of "A" and "B" voltages, grid and plate currents, power output, frequency and deviation have no substitute; their meaning is definite. Experience will indicate to what degree variation can be tolerated.

Netting of receivers and transmitters in any system is more important than usually realized. The term "netting" means that all receivers and transmitters in a given system are aligned on the same frequency. With modern selectivity requirements, it is more than ever necessary to tune every receiver exactly to the station it must receive. Careful "netting" of all units in an integrated system to the correct frequency is a first-order requirement of a modern communications system and will eliminate a prime cause of poor system performance.

Frequent checks of transmitter deviation will also do much to improve system operation. Frequency and deviation checks are more important from a system operation standpoint than the twice-yearly FCC regulations seem to indicate. The technician should be sure that transmitters are swinging a normal $\pm$ 15 kc for standard channel and $\pm$ 5 kc for split channel operation. Underdeviation does not develop the full advantages of frequency modulation.

A good rule to follow is to check performance frequently and make adjustments only when actual tests and measurements show improper operation. Adjust nothing without meters and signals to indicate actual conditions This is one area in which your ear isn't a good meter.

A good preventive maintenance program would require a complete system check at least every three months. In a general way the following items should be part of any preventive maintenance routine.

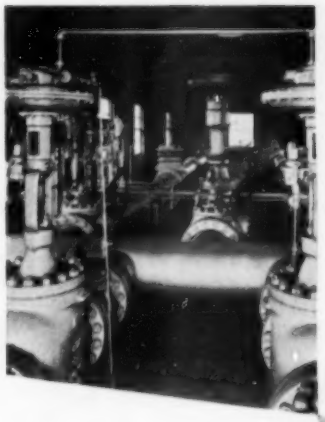
1. Clean and dust thoroughly.
2. Check primary voltage circuits.
3. Measure power output of transmitters.
4. Measure sensitivity of receivers.
5. Check meter readings at the metering positions of transmitters and receivers.
6. Check audio output of receivers and audio input to transmitters.
7. Check operation of all relays.
8. Measure frequency and deviation of transmitters.
9. Check and adjust frequency netting of the entire system.
10. Check all accessories, control heads, cables, microphones, pilot lights, etc.
11. Check the antenna system.
12. Check and adjust remote control levels.
13. Check power supply output voltages.
14. Actually make an operational listening test of transmission and reception.

The success of preventive maintenance procedures will depend on the attention paid to each detail of the system maintenance program. Such a program intelligently applied as a planned, periodic, complete system inspection will pay off in dollars, as well as in continued good system operation. It will give greater satisfaction in operation of radio communications and it will insure continued reliable communications at all times. Best of all, perhaps, you will have the inner satisfaction of a "job well done."

We find that a good preventive maintenance program will be successful if we but follow some basic rules dilligently such as:

1. Maintain primary power at proper levels.
2. Check system netting frequently.
3. Be observant and react to your senses: hearing, seeing and feeling.
4. Keep equipment clean and dry.
5. Keep individual records of each unit.
6. Do believe the user. If he says the operation is faulty, you may be quite sure the system is not working properly even though his description of the trouble may not be quite accurate, or your cursory test may indicate that everything is all right. Search out and find the difficulty.
7. Follow your preventive maintenance program consistently; perform each recommended procedure without fail.

Appreciation is expressed to Frank Bramley, Motorola's New England regional service manager, for his contributions in the preparation of this article paper. ■



Algonquin Gas Transmission Company reports:

Bell System channels for telemetering help boost both sales and service

At the right is a view of the dispatching center of the Algonquin Gas Transmission Company in Boston. Above is shown one of the company's metering and regulating stations.

Load shifting by remote control, made possible by Bell System channels for telemetering, is helping increase sales and improve service for the Algonquin Gas Transmission Company.

This company supplies natural gas at some 39 delivery points to 23 different utilities throughout the New England states.

Because the Algonquin dispatcher has a running check on pressures throughout the system, he can constantly shift the load, thereby insuring the maximum flow of gas through the pipe at all times. This means increased sales and extra service for satisfied customers.

In addition to the constant check between anticipated demand and actual load conditions, Algonquin's system-wide telemetering has other benefits—instant detection of threatened freeze-ups and line obstructions—maintenance of predetermined pressure for each customer—thorough knowledge of conditions on the entire pipeline system.

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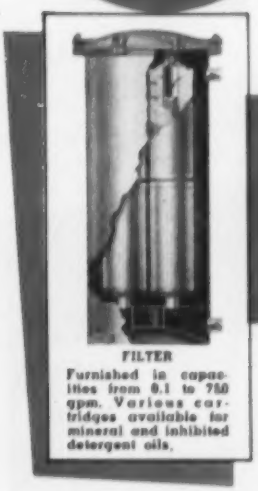

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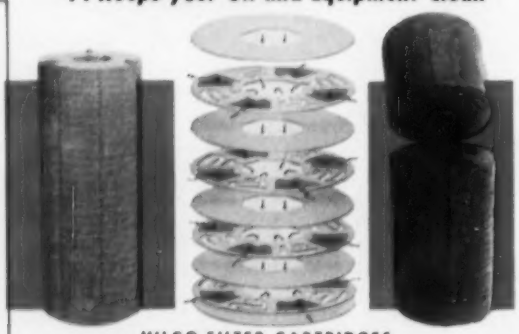

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GAS

pipeline news

TET files with FPC for Mexican import okay

Texas Eastern Transmission Corp., Shreveport, has filed applications with the FPC (Docket G-9784, -85, -86, and -87) for authority to import natural gas from Mexico and to construct and operate facilities to expand its system capacity by 250MMcf/day.

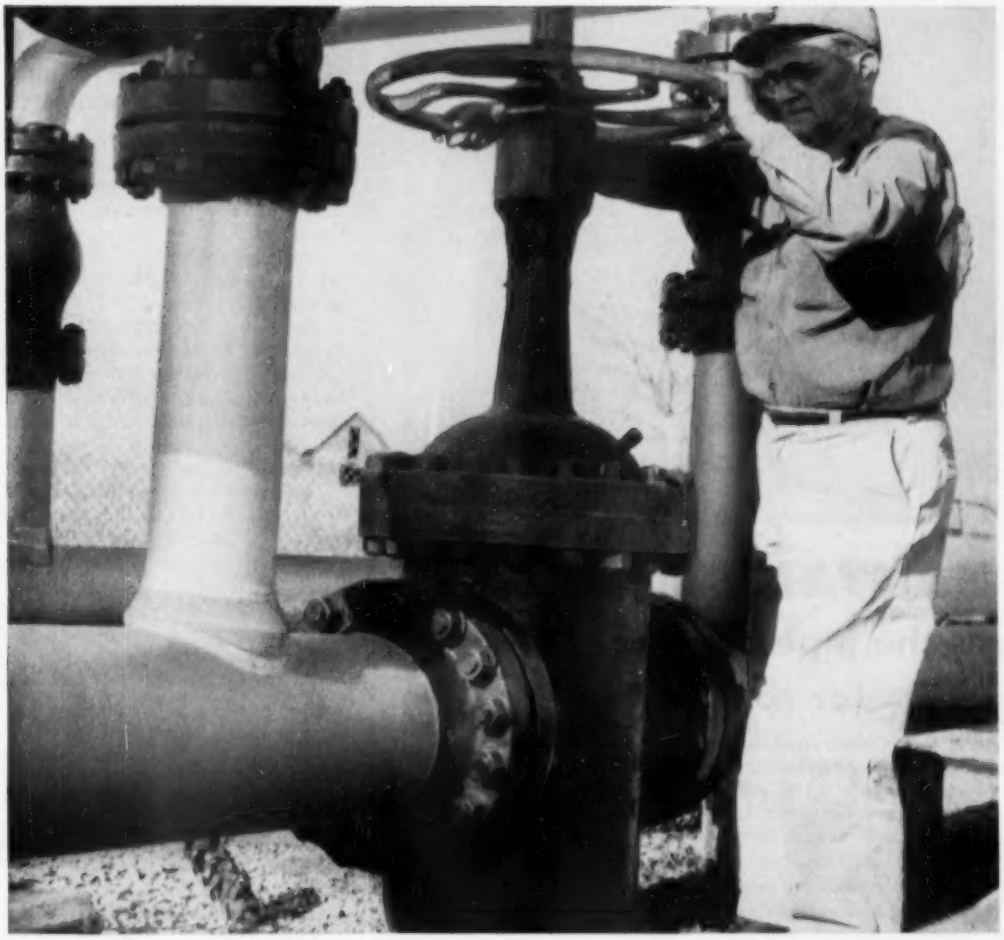
As proposed, the $150 million project would consist of a 422-mile, 30-in. line from its present facilities near Beaumont, Texas, southeast to McAllen, Texas, on the Mexican border, plus 530 miles of loops on its present 30-in. line from Beaumont to New Jersey, supply and sales laterals, 50,000 hp at five new compressor stations, and 20,780 hp additional at existing stations.

Texas Eastern recently (See Pipeline News, November GAS) negotiated a contract with Pertoleos Mexicanos through which TET can purchase and receive at the international border up to 200 MMcf/day. "This contract, together with other substantial reserves dedicated to Texas Eastern and evidenced by gas contracts filed with the application, provide ample basis for the construction of the proposed facilities and the transportation of the stated quantities of gas to supply market demands," said George T. Naff, Texas Eastern head.

TET's wholly owned subsidiary, Texas Eastern Penn-Jersey Transmission Corp., in Docket G-9787, seeks approval of 33,000 hp added compression from the Oakford storage field in west Pennsylvania to the East Coast. Capacity would rise from the present 300 MMcf a day to 500 MMcf.

• • •

Almost the the same time that Texas Eastern was filing its applications with the FPC, Petroleos Mexicanos announced the opening of its $10 million natural gas absorption plant at Regnosa, across the border from McAllen. This is the plant from which TET will get its gas. It has a capacity of 300 MMcf of gas a day. In addition to the export market, it will supply industrial clients in northern Mexico.



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THE CASE HISTORY—More than 3 years ago the Phillips Pipe Line Co. installed this Crane conduit valve in a junction manifold on its 10-inch crude line to Borger, from Yale Station, Oklahoma. How's it doing?

Operated every day or two until a few months ago, this Crane double-seating, grease-packed valve has always responded smoothly and easily to the handwheel—never sticking. Under former frequent usage as now with infrequent operation, it has never leaked at the bonnet joint or packing chamber—remains tight as new at the seats. This Crane valve—because its pressurized stuffing box eliminates leakage—is clean, unstained.

On gas and oil, these Crane valves are making big savings in operating costs. They're the leading value for pipe line service, and thrifty buyers know it.

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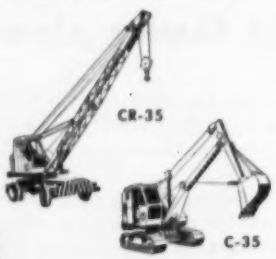

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pipeline news • *Cont'd.*

Gas and oil conservation bill urged for Colorado

Legislation to "prevent a great waste of oil and gas in the Rangely field" was urged by Colorado's Governor Johnson in his message to the state legislature last month.

He pointed out that the Colorado lawmakers had failed to clarify provision in the 1951 state oil and gas conservation measure and that the U. S. Supreme Court last year handed down a decision preventing the State Oil and Gas Conservation Commission from enforcing rules concerning orders of the commission against flaring of gas and for reinjection of gas in the field.

"If you want to prevent the waste of oil and gas in Colorado," Johnson told the solons, "you will need to give the commission the power and authority to prevent such waste.

"Under our tax provisions, which are generous to the oil industry, good conservation practices in Rangely field would produce $40 million more taxes than wasteful methods where conservation practices are not followed.

The governor asserted that a "real emergency" exists and that "all is chaos" at Rangely, that one oil operator had bluntly informed the commission it had no power to enter orders and threatened suit unless proposed orders are rescinded.

Johnson said he had asked the state attorney general to prepare a bill "which would enable the commission to do the job for which you created it without giving it undue authority which it should not have."

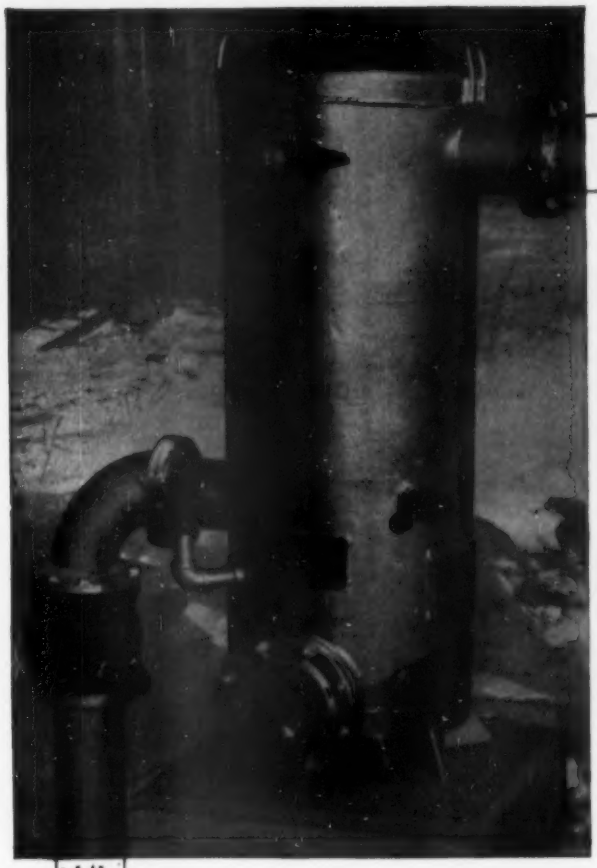
Montreal's gas prospects brighten with new agreement

With the signing of a transportation contract between Niagara Gas Transmission Ltd., a wholly owned subsidiary of Consumers Gas Co. of Toronto, and Trans-Canada Pipe Lines Ltd., natural gas service for Montreal has been brought a step closer.

The contract enables Trans-Canada to utilize the surplus capacity of the present Niagara-Toronto pipeline to carry gas to the new pipeline Trans-Canada plans to build this year from Toronto to Montreal.

Although built and owned by Trans-Canada, the Niagara-Toronto line was leased to Niagara Gas to carry U. S. gas to Toronto until western Canadian gas arrives in eastern Canada.

N. E. Tanner, TransCanada president, said the transportation contract would enable his company to provide natural gas services to the communities between Toronto and Montreal, as well



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Photograph shows a 24″ diameter Blaw-Knox low-height Gas Cleaner which is only 71″ high over-all. Low height was very desirable in this installation because it saved on construction costs of the building to house the cleaner and the pressure regulators.

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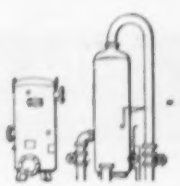

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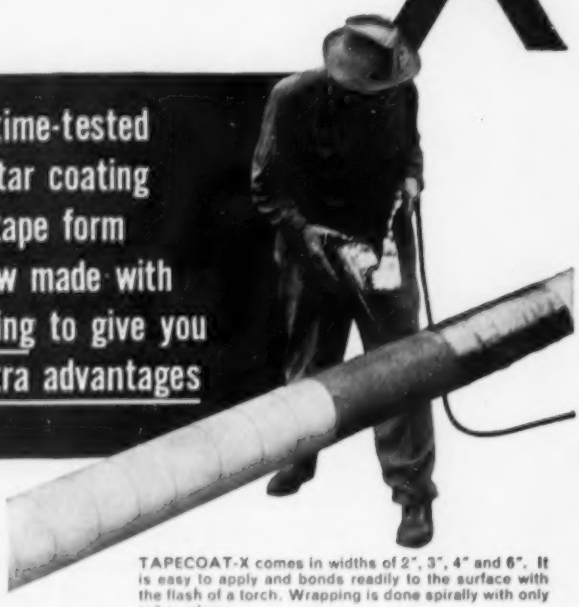

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XTRA CONVENIENCE! New type, self-disposing liner facilitates unrolling, speeds application, never gets in your way.

XTRA ECONOMY! TAPECOAT-X goes farther, gives you more value for your protection dollar.

Write today for the complete facts on this timely development for protecting pipe, pipe joints, mechanical couplings, tanks and other steel surfaces vulnerable to corrosion, above and below ground.

The **TAPECOAT** Company

ORIGINATORS OF COAL TAR COATING IN TAPE FORM

1535 Lyons St., Evanston, Illinois

as Montreal itself, a year before they could be served by Canadian gas.

Another Trans-Canada development was the announcement by Mr. Tanner that approximately 80% of its natural gas requirements will have been obtained in a series of contracts already signed and in the process of being signed.

The agreements provide contract quantities of gas that assure the pipeline of 437 MMcf of gas per day. Both independent operators and major producing companies are involved. The field included are among those whose gas supplies have been dedicated to Trans-Canada by the Alberta petroleum and natural gas conservation board. Negotiations are under way now for the balance of TransCanada requirements.

FPC orders Panhandle to refund $36 million

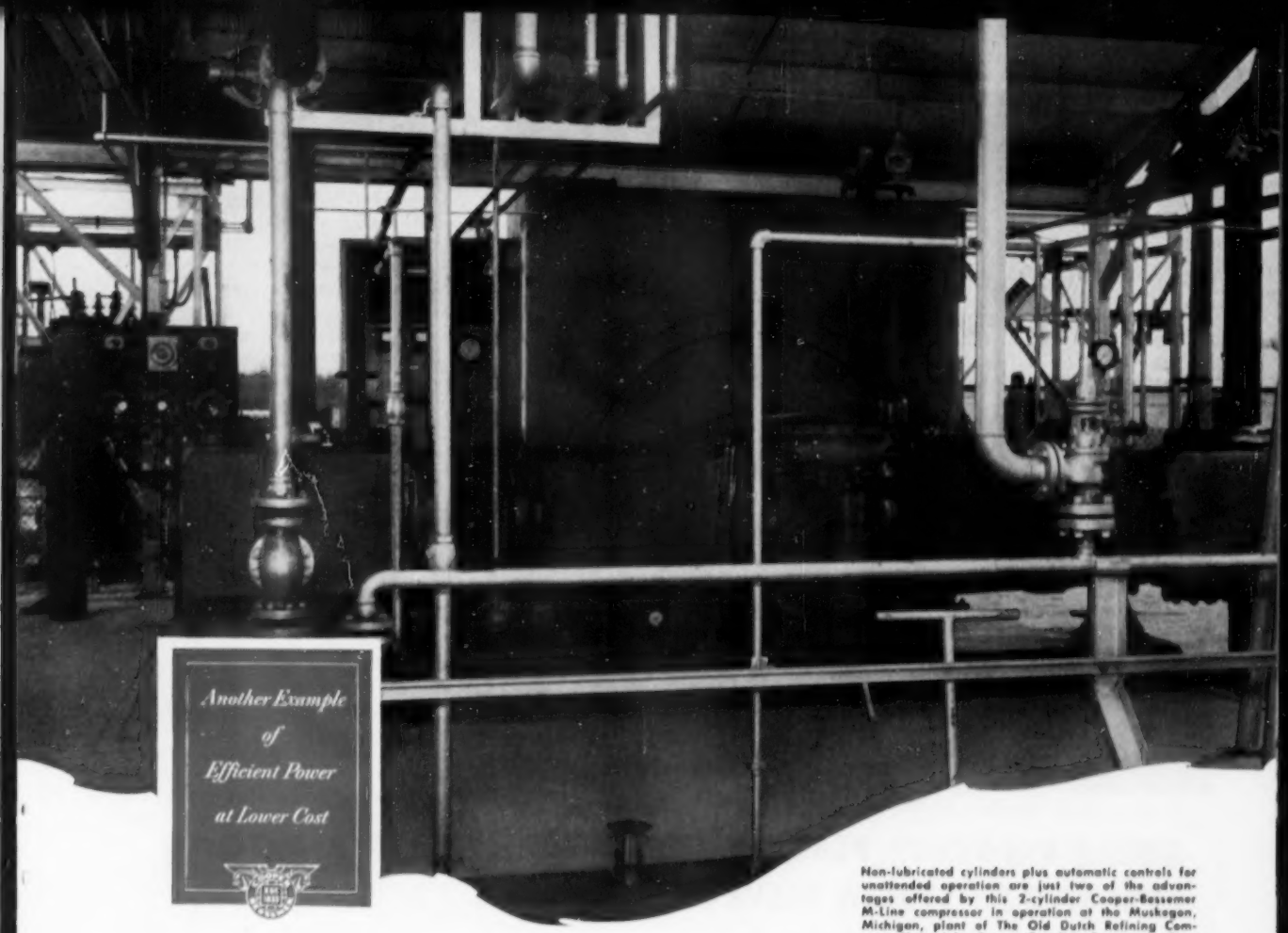
The Federal Power Commission has issued an interim order directing Panhandle Eastern Pipe Line Co., Kansas City, Mo., to refund a total $36,116,056, plus interest at 6% annually to its wholesale natural gas customers for the period from Feb. 20, 1952, through April 30, 1954, when a rate increase was in effect subject to refund of any excess charges (Docket G-1116, et al).

The commission specified, however, that its action was without prejudice to further refunds which may be appropriate as the result of a court order remanding the Panhandle rate case decided in Opinion No. 269 to the FPC for further proceedings on two issues—the treatment of the cost of company-produced gas and the treatment of revenues and expenses from gasoline plant operation (see January GAS, p. 132).

The rate refund case arose from a commission opinion (No. 269) order issued April 15, 1954, prescribing wholesale rates for Panhandle which, based on the test year 1952, reduced the amount of a proposed increase from $21,400,000 per year to $12,778,864 annually. Although the new rates became effective May 1, 1954, the $21,400,000 increase had been in effect, subject to refund, since Feb. 20, 1952.

In its April 1954 order, the FPC said it would not determine the disposition of the refund amounts until it had a chance to study actual operating results throughout the entire refund period. The commission subsequently reopened the record of the proceedings to determine the just and reasonable rates for the period and to determine the excess charges collected by Panhandle during that period.

In the meantime, however, the City



Non-lubricated cylinders plus automatic controls for unattended operation are just two of the advantages offered by this 2-cylinder Cooper-Bessemer M-Line compressor in operation at the Muskegon, Michigan, plant of The Old Dutch Refining Company (leased by Aurora Gasoline Company) where the UOP Platforming process is in use.

"HYDROGEN COMPRESSES CLEAN"

... with Cooper-Bessemer's non-lubricated cylinders

RECYCLING millions of cubic feet of hydrogen a day for the UOP Platforming of low-octane gasoline, demands continuing efficiency from a smooth working compressor that will not contaminate the recycle hydrogen. That is one of the reasons why The Old Dutch Refining Company, leased by Aurora Gasoline Company, recently installed a 2-cylinder Cooper-Bessemer FM compressor in their modern plant in Muskegon, Michigan.

To avoid contaminating hydrogen with oil in the recycle gas, Cooper-Bessemer successfully developed a non-lubricated compressor cylinder.

Operating against micro-smooth hardened cylinder liners, these 8" diameter carbon pistons require no lubrication whatever. With a mirror finish, the cylinder bores reveal no excessive wear.

No matter how exacting or complex your compressor problems, check the advantages offered by Cooper-Bessemer M-Line compressors. For dependability and money-saving operation, you can rely on Cooper-Bessemer — one of America's oldest engine builders offering the latest in engineering advancements.

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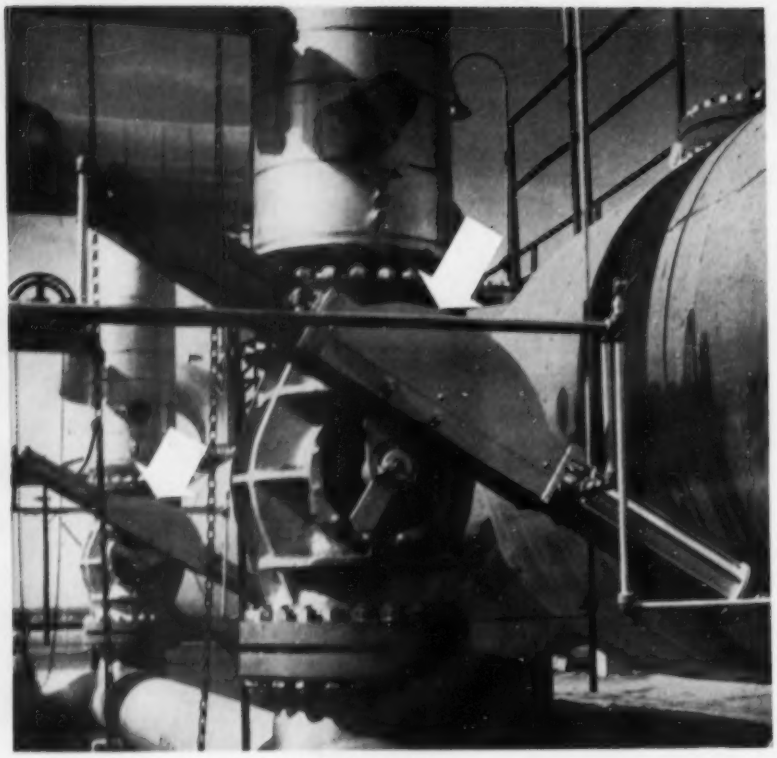
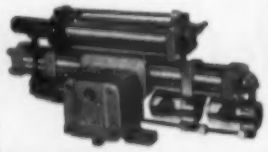


(Unretouched photo of Ledeen Valve Actuators in operation)

AMINE RECOVERY PLANT PLUG VALVES OPERATED BY LEDEEN VALVE ACTUATORS

Natural gas companies find these operators safe, positive, dependable for automatic operations



LEDEEN TIME DELAY VALVE

When lightning strikes or power fails, this new valve keeps station on line. If power is not restored within adjustable time delay limit set by the valve (2 seconds to 2 minutes), station is blown down and lines vented. Write for data on this compressor station watchdog.

Ledeen Valve Actuators are used in compressor stations on automatic blowdown valves, fuel shutoff valves, relief valves, pipeline and station block valves, and many more applications along with the Amine Recovery Plant installation shown.

These valve actuators are pneumatically and hydraulically operated, do not leak and are easily mounted by field personnel without modification of plug valve. They can be mounted in any position around the valve; and are available with auxiliary manual operation, either at valve or at a remote location. For preventive maintenance, actuator and control system can be operated without turning the valve. Torque ranges from 500 to 500,000 inch pounds.

WRITE FOR BULLETIN 3020.

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VALVE ACTUATORS
AIR HYDRAULIC
PUMPS & BOOSTERS

Ledeen Mfg. Co.
1608 So. San Pedro St.
Los Angeles 15, Cal.

pipeline news • *Cont'd.*

of Detroit and Wayne County, Mich., appealed the Commission's April 1954 opinion and order, and the U. S. Court of Appeals for the District of Columbia Circuit on Dec. 15, 1955, remanded the case to the FPC for further proceedings on the two issues.

The commission said that the "public interest requires" that the pendency of the further proceedings should not delay the immediate refunding of those portions of the excess charges not questioned by the court's decision. The FPC said that its order is without projudice to further refunds which may be appropriate as the result of the further proceedings. The commission further said that it was reserving decision on the issue of the allocation of costs to Panhandle's transportation and sale of heavier hydrocarbons to the National Petro-Chemical Corp. plant, since it may be affected by further consideration of the treatment of gasoline plant revenues and expenses. The commission said that while it was suing the volumetric method of allocation advanced by Panhandle in computing the interim refund, this was not to be construed as approval of that method and is in no way determinative of the final decision.

The commission found, subject to these reservations, that just and reasonable rates for Panhandle, based on a 5¾% rate of return, during the refund period would result in revenues totaling $147,173,415 instead of the $183,289,471 actually collected by the company. The FPC's order directs Panhandle to refund the difference—$36,116,056—to its customers within 15 days, together with interest at the rate of 6 percent per year.

Eastern North Carolina gas certificate awarded

North Carolina's utilities commission has given the green light to North Carolina Natural Gas Corp. to proceed with plans to serve a large area of eastern North Carolina with natural gas. Alex B. Andrew, company attorney, said the utility would proceed to get contracts with municipalities and industries.

Plans call for the North Carolina firm to tie onto Transcontinental Gas Pipe Line Corp.'s line near Mooresville. North Carolina Natural plans to build 577 miles of pipeline from a point near Charlotte through the southern part of the state to the coast.

Cities it will serve include Albemarle, Aberdeen, Clinton, Dunn, Fayetteville, Goldsboro, Greenville, Hamlet, Kinston, Monroe, New Bern, Pine-

Model 705 Barber-Greene Runabout digs through toughest soils. High travel speed cuts time and cost of service trenching.

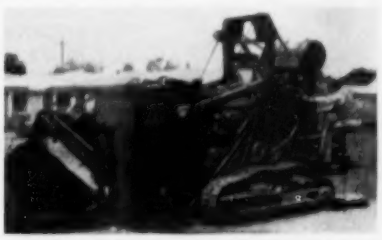
For lowest-cost trenching . . . choose the ditcher that's right for you

The first step in reducing ditching costs is to select the machine that meets your requirements. Ground conditions . . . digging range . . . job to job portability —all are factors that change with varying trenching operations. That's why Barber-Greene builds *four* distinctively different ditchers—each with special features that give it unsurpassed performance within its field.

Take the Model 705B Runabout for instance. Long a favorite for house service trenching, this versatile ditcher features the exclusive vertical boom that digs right up to obstacles leaving no ramp . . . Hydra-Crowd that gives finger-tip control of maximum crowding speeds independent of bucket line speed . . . and Fluid Coupling that eliminates shock loads.

Model 711 for widely scattered jobs. A 45 m.p.h. travel speed reduces between job time to a minimum. Digs to 5′ deep, and 18″ wide.

Model 702 for narrow trenches. A remarkably low-cost unit ideal for cable, conduit or small pipe. Digs 2¼″ to 5″ wide, to 40″ deep.



Model 44C for heavy-duty trenching. Crawler mounted for sure traction on soft bases, this Barber-Greene cuts to 8′ 5″ deep, and to 24″ wide.

56-4-D

Write for literature on any ditcher in the Barber-Greene line

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CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT

hurst, Rockingham, Rocky Mount, Selma, Smithfield, Southern Pines, Washington, Wilson, and Wilmington.

Officials of the company, headed by P. McDonald Biddison as president, said they hope to have natural gas in the area by next fall.

Construction record in sight for Pacific NW line

On Jan. 1, 234 days after completion of financing of the Pacific Northwest Pipeline Corp. project to bring natural gas from the San Juan basin of New Mexico to the Pacific Northwest, builders of the line had passed the halfway mark in the construction of the 1487-mile line and were poised on a downhill grade and shooting for an all-time high completion record.

Record in the making—Part of the 750 miles of natural gas pipeline put in the ground in 174 days of construction time in 1955 by Fish Northwest Constructors Inc. for Pacific Northwest Pipeline Corp. is this section of 22-in. pipe in eastern Oregon. This pipe is being wrapped with asphalt tar and fibre glass as a protection against corrosion.

A review of progress by Fish Northwest Constructors Inc., builders of the line, shows tremendous accomplishments.

More than 750 miles of 26- and 22-in. steel pipe had been put in the ground. One stretch of 387 miles, from Ignacio, Colo. to Green River, Wyo., could carry gas.

Early in January, in defiance of deep snows and severe temperatures, nine construction spreads and seven river crossing crews were racing to fill the remaining gaps in the 1070 miles between Ignacio and Umatilla, Ore.

El Paso Natural enters synthetic rubber field

El Paso (Texas Natural Gas Co. has entered the chemical industry with an agreement with General Tire & Rubber Co. to build integrated synthetic rubber producing facilities near Odessa, Texas.

Paul Kayser, El Paso's president, and William O'Neil, president of General Tire, said the multi-million dollar project would be the first synthetic rubber plant built since World War II and also the first to be privately financed. Cost is estimated at $28 million.

General Tire will build a copolymer plant with an annual producing capacity of 40,000 long tons of general purpose synthetic rubber. The raw materials for GR-S will be supplied from

OWENS-CORNING GLASS PIPE-WRAP

POSITIVE PERRAULT PIPE PROTECTION

Owens-Corning Fiberglas Coromat pipeline wrap is available through Perrault Equipment Co. in average thicknesses of .020 and .025 in.; in widths from two to 18 in.; and roll lengths of 400, 800, and 1200 ft. High strength and porosity combined with inert reaction to weather, chemicals and electricity make this the best pipeline coating reinforcement. For the best service, get it from Perrault Equipment Co.

ALSO: Asbestos Pipeline Felt • Pipeline Kraft Wrap • Rock Shield

AND FOR DEPENDABLE APPLICATION: Perrault Line Travelling, Over-the-ditch, Coating and Wrapping Machines and Yard or Railhead Stationary Coating and Wrapping Machines.

ALSO: Cleaning and Priming Machines • Tar-Heating Kettles • Beveling Machines • Digging Teeth • Tongs • Welding Clamps • Line-Up Clamps • General Pipeline Hand Tools and Supplies . . .

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Foxboro Flow Meters get "sea-duty" measuring gas flow on platform in Gulf of Mexico. Well pressure is 1900 lbs.; pressure upstream from chokes 800 lbs.; meter-run pressure 500 lbs.

. . . Foxboro Flow Meters

Rugged, accurate, thoroughly dependable — whether they're measuring gas flow on an off-shore platform or on a wind-swept desert! That's the field performance record of Foxboro Flow Meters . . . the reliable, economical means of charting and prorating well production.

Basic "better-design" of these Foxboro Meters *assures* accuracy with essentially *no* maintenance! For example, transmission of float motion to the pen is *linear* — through the exclusive segmental lever drive and "life-lubricated" anti-friction bearing. There's no calibration compromise . . . no lost motion. And these are only a few of many engineered advances that pay off in troublefree gas measurement.

There are Foxboro Flow Meters for all production pressures. Especially adapted to field metering, the Type 22 is popular for working pressures to 2000 psi. The heavy-duty Type 26 is widely used for working pressures to 5000 psi. For complete details, write for Bulletin 460-2.

THE FOXBORO COMPANY, 342 NORFOLK STREET, FOXBORO, MASS., U. S. A.

FOXBORO REG. U. S. PAT. OFF. **Oil and Gas FLOW METERS**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

butadiene- and styrene-producing facilities to be built by El Paso and Odessa Natural Gasoline Co.

Construction is scheduled to begin immediately, with production to start about July 1, 1957.

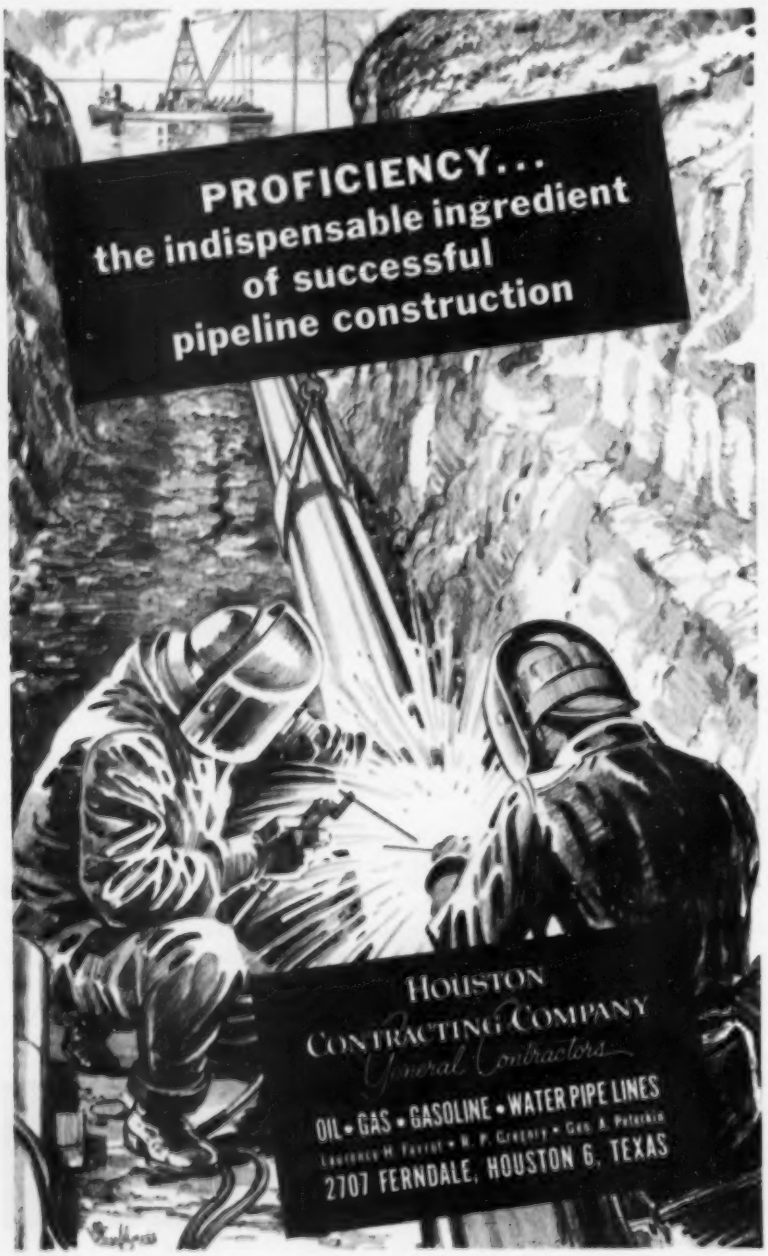
Terming the agreement highly significant to all parties, Mr. Kayser said, "We now have a stream of natural gasoline, butane and propane of approximately 25,000 bbl a day—and this is rapidly increasing—and we came to the conclusion . . . that we should utilize this stream for production of these chemical products which are basic to these streams. These, of course, included styrene and butadiene."

Iowa tax commission wins use-tax court fight

The Iowa supreme court has ruled that the Iowa State Tax Commission has the right to assess a use tax on certain property that eventually may be used in interstate commerce.

The opinion was handed down on an appeal by the tax commission from a district court ruling that held the commission's use tax assessment against Michigan-Wisconsin Pipe Line Co., Detroit, was invalid. The lower court had held that property brought into the state by Michigan-Wisconsin for use in the building of a compressor station and auxiliary buildings of an interstate pipeline system could not be taxed.

In its unanimous decision, the supreme court held that the property was subject to Iowa use because it "came to rest here" prior to its actual installation as part of the interstate system.



Panhandle Eastern wins round in court

A temporary victory has been won by Panhandle Eastern Pipe Line Co. in its fight to block large shipments of gas from the Gulf Coast to the Midwest. The U. S. court of appeals for the District of Columbia denied without prejudice motions filed by the FPC and the American Louisiana Pipe Line Co. to dismiss Panhandle's challenge of an order approving arrangements for four producers to sell natural gas to American Louisiana for its pipeline project.

The court said it had taken its action in order to further consider the controversy on its merit after it hears the issues in full at a later date. The court also said the case presents the first test of FPC action since the Phillips ruling.

Colorado Oil acquires assets of Lawton Oil

Colorado Oil & Gas Corp., Denver, will acquire all assets of Lawton Oil Corp., Magnolia, Ark., according to W. C. Norman, president of Colorado Oil, and R. G. Lawton, who heads the company operating under his name.

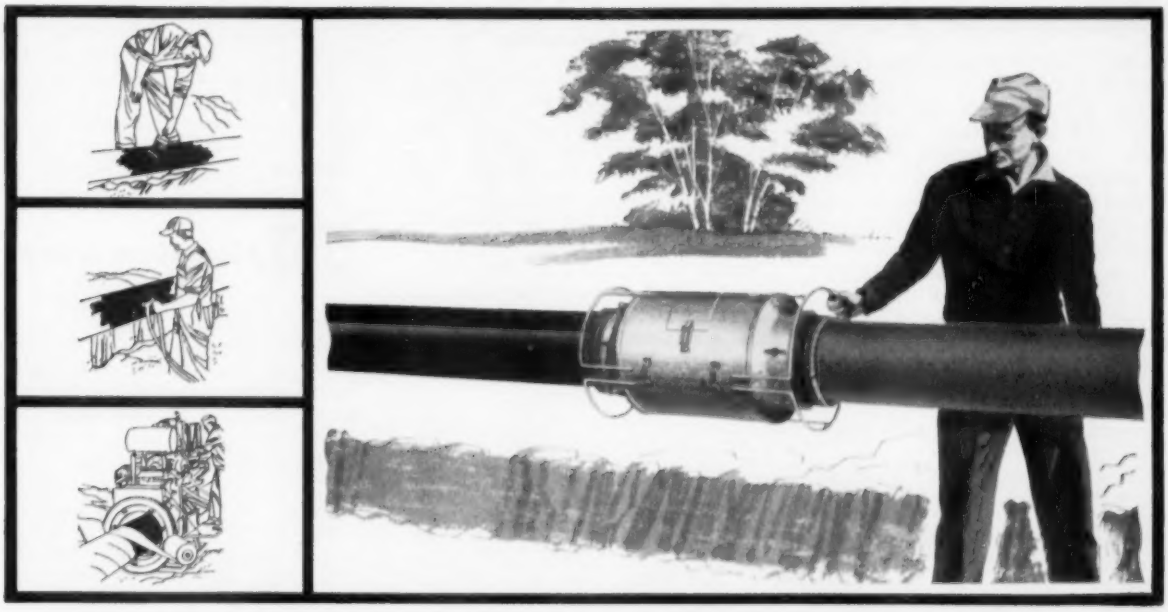
Besides adding to the substantial gas production of Colorado Oil, the acquisition will increase its daily oil production by about 1500 bbl.

Lawton's producing properties are located principally in Arkansas, New Mexico, and Texas. In addition, 35,000 acres net interest in 129,000 acres of unproven leases located in the south Mid-Continent area are involved.

SoCal and SoCounties plan line construction

Following FPC approval the plans of Southern California and Southern Counties Gas Co.s to take an additional 177,013,000 cu ft of gas a day from El Paso Natural Gas Co. (see GAS, January, p. 127), the two California utilities asked the state PUC for permission to build a pipeline to take the additional supplies.

The 236-mile, 30-in. line will extend from Newhall to Topock, Ariz.,



ROSKOTE Cold Applied Pipe Mastics

EASY TO APPLY—FAST DRYING—HIGH ELECTRICAL RESISTIVITY

Because of their ease of application and extremely fast drying time — because they possess the highest electrical resistivity of any cold coating and offer the least amount of objectionable fumes and skin irritants — Roskote pipe mastics have been field approved by more and more leading utilities each year.

In fact, Roskote has been specified by over 200 oil and gas companies for the protection of their natural gas, oil and product pipelines.

A new folder on Roskote, which includes a complete description of its properties, application instructions and full test data, is now available. The test data is of special importance because it gives specific figures on volume resistivity during and after drying.

For a copy of this new folder on Roskote or literature on any other Royston product, just drop a line to Royston Laboratories or any of its district sales offices.

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pipeline news • *Cont'd.*

on the Colorado river, where it will meet El Paso's line.

Cost of the line and auxiliary facilities, which will include a station and three 1760-hp compressors at Topock, is estimated at $23,638,800.

Also scheduled for construction, and a part of the current application, is a 30-in. line from Alhambra to Newhall.

Completion of both lines is scheduled for 1958, at which time out-of-state deliveries to the southern California companies will top the 890 MMcf daily mark.

FPC received 13,531 rate filings in 18 months

In the first 18 months following the Phillips decision, the FPC received a total of 13,531 rate filings from independent producers, including a total of 3229 rate increases amounting to $48,546,537 annually, according to figures released by FPC Chairman Kuykendall.

Of the 3229 increases, the FPC suspended 221, totaling $15,798,041 annually. Of the suspended increases, 189 for $14,707,869 yearly, were still pending as of Dec. 1, 1955.

The filed increases included 1978 tax increases for $6,904,444 per year, and 1030 other type increases, totaling $25,844,052, all of which were allowed without suspension. Seventeen increases, for $761,197, were suspended but later allowed without hearing, and 15 others that the FPC suspended were subsequently reduced and withdrawn.

JETCO JIFFY® HEAVY DUTY EQUIPMENT

FOR ALL TYPES OF TRENCHERS

HEAVY DUTY WHEELS

Fabricated of high alloy steel for long wear.

Standard ¾", ⅞", or 1" thicknesses, or to specification.

Standard or specified diameters.

Holes pre-drilled for bucket installation.

Shipped ready for installation.

Photo of Cleveland 320 heavy duty wheel, buckets and teeth.

HEAVY DUTY BUCKETS

Fabricated from high quality steel in ⅝", ¾" and ⅞" thicknesses. • No further welding or hole drilling necessary. • Jetco weld-on pockets give added strength to bucket. • Pre-drilled holes for side-cutters included.

Shipped ready for installation.

HEAVY DUTY TEETH & POCKETS

Drop-forged, weld-on pocket with smooth radius for positive taper fit with Jetco Jiffy Teeth—no bolts. • Self-sharpening, quick change, reversible teeth of high quality steel for longer wear. • Teeth designed for all types of soils. • Minimum leading edge leverage.

Write for catalog

JETCO, INC.

Dept. C, 1100 Westminster Avenue

Alhambra, California

GAS pipeline notes

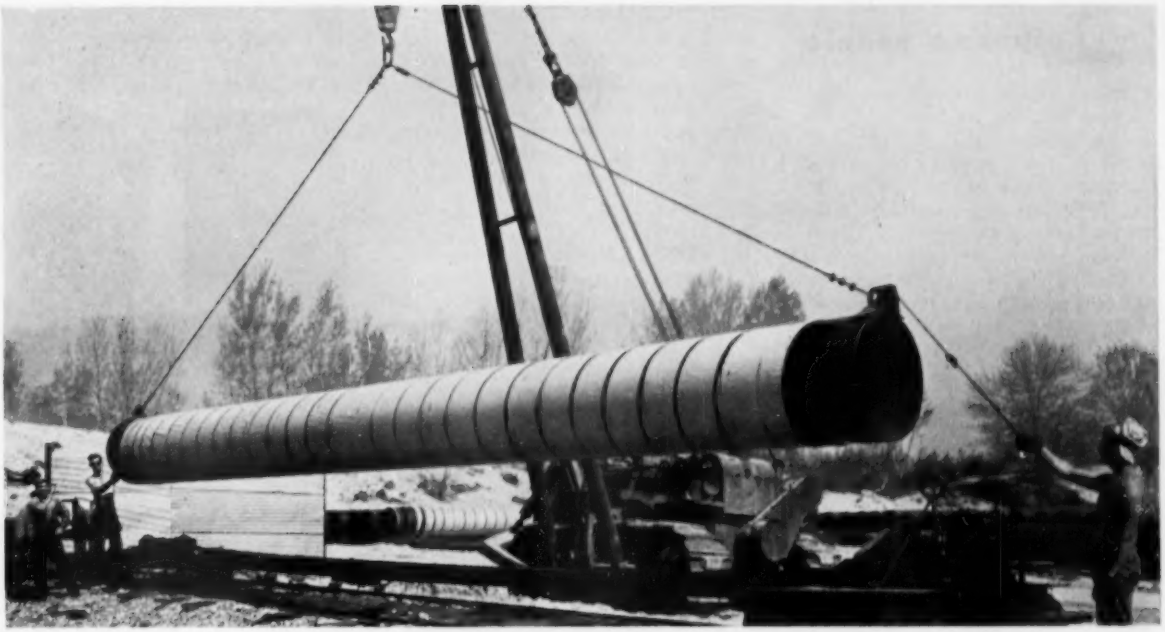
Montana-Dakota Utilities Co., St. Paul, has been authorized by the FPC to acquire the pipeline facilities of Montana-Wyoming Gas Pipe Line Co. located in Wyoming and Montana. The properties have been operated by M-D under arrangements. Montana-Dakota will issue 241,577 shares of common stock of Montana-Wyoming in exchange for all of the latter's properties and assets, and will assume Montana-Wyoming's $4,874,000 first mortgage pipeline bonds.

Long Island Lighting Co. has received PSC authority to construct an 8-mile, 24-in. line from the recently authorized Brooklyn Union Gas Co. line at the Queens-Nassau county line (see GAS, January, p. 130). The line will increase the gas supply for the company's service area, which includes Nassau, Suffolk and southwestern Queens counties.

Merger of Norristown Magnesia & Asbestos Co., Sall Mountain Co., and Valley Forge Metals Co. into Nicolet Industries., New York, has been announced. The companies, all wholly owned subsidiaries of Nicolet, will become divisions of the parent.

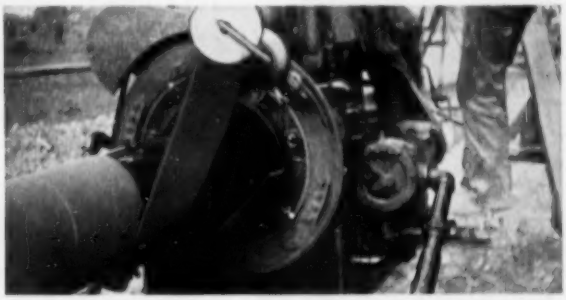
Texas Gas Corp., Houston, has completed an approximate $20 million refinancing of its present long-term debt held by Metropolitan Life Insurance Co. Russell M. Riggins, company president, stated that the refinancing of the long-term debt will permit further expansion of company facilities and continued growth of its operations.

Foxboro Co. is doubling the size of its facilities for training instrument personnel at its Foxboro, Mass., training and education center. Scheduled for completion early this year, the new building will accommodate 46 trainees, nearly twice the number handled previously. Plans call for two 20-student classrooms, two laboratories, an instrument demonstration room, a conference area, and enlarged quarters for the expanding teaching staff.



KING SIZE PROTECTION: 36" pipe, mill coated first with NO-OX-ID 6X for bonded insulation against moisture, then shielded with No. 7 NO-OX-IDized Wrapper and Service Coat for added electrical resistance and protection against soil stress. Finally, a kraft wrap to protect from damage in handling operations. This is long-term pipeline protection at its best.

WHERE ELBOW ROOM IS SCARCE: In crowded work space, No. 4 NO-OX-IDized Reinforced Fabric Wrapper is hand applied around irregular fittings such as valve manifolds on gas lines. No. 4 Wrapper, a coated fabric laminated to a plastic membrane, provides moisture-proof seal over pipe coating.



PROTECTION BY THE MILE: A NO-OX-ID coating combination is uniformly applied over-the-ditch by this traveling type machine. The NO-OX-ID 6X Base Coating is covered with an unbroken shield of No. 7 NO-OX-IDized Wrapper. The fabric side of the wrapper is an excellent surface for bonding a service coat.

NO-OX-ID PROTECTS...EVERYWHERE

Wherever pipelines go—into long or short line service, through rough terrain or rolling plains—there is a NO-OX-ID coating combination plus a method of application for long-term protection against corrosion.

WRITE FOR BULLETIN "Protecting Underground Pipe from Corrosion with NO-OX-ID and NO-OX-IDized Wrappers" tells the story. Your copy is ready upon request.

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Merchandise Mart Plaza, Chicago 54, Ill.

Gentlemen:
Please send my copy of "Protecting Underground Pipe from Corrosion with NO-OX-ID and NO-OX-IDized Wrappers."

Name ..... *Title* .....

Company .....

City ..... *Zone* ... *State* .....

Dearborn NO-OX-ID

Protecting Metal Against Corrosion Since 1887

GAS pipeline people

Texas Gas Transmission Corp., Owensboro, Ky., has announced the following appointments: FORREST W. LEWIS JR., formerly senior engineer in the measurement and research department, has been named manager of the newly created gas storage department. AARON GRIFFIN has been appointed to the newly created post of assistant superintendent in Pipeline Division II, which includes pipeline operations from the Kentucky-Tennessee border north. He is succeeded as manager of the Owensboro pipeline district by HUGH OWEN. JOSEPH N. BOWERS is now manager of the company's employment program; AMOS R. MARTIN is manager of the insurance and retirement programs; and JOSEPH W. CASTLEN JR., is manager of wage administration.

DAVID M. SALLS has been appointed home office manager of the gas and oil industry sales engineering section of Cooper-Bessemer Corp., Mt. Vernon, Ohio. He will be responsible for coordinating the efforts of the home office engineering group directly supporting C-B's field sales activities in the oil and gas industries.

D. M. Salls
Cooper-Bessemer

R. J. Fitzpatrick
Texas Eastern

ROBERT J. FITZPATRICK has been appointed director of public relations for Texas Eastern Transmission Corp., Shreveport. In addition to the company's public relations, he will be in charge of publications and advertising. Mr. Fitzpatrick was formerly vice president of Albert Frank-Guenther Law Inc. Other TET assignments include J. E. BIXBY to assistant treasurer and W. T. THAGARD III to director of plans and economic research.

ROBERT L. BOWMAN, manager of construction for Bechtel Corp.'s pipeline division, has been elected a vice president of the affiliate, Bechtel International Corp.

A. B. Hiatt

R. C. Frederick
Pacific Northwest

R. C. FREDERICK and ALLEN B. HIATT, both veterans of the natural gas industry, have been elected vice presidents of Pacific Northwest Pipeline Corp. For 28 years, Mr. Frederick was employed by Gulf Oil Corp. and was coordinator of gas and gas liquids production departments for that company. Mr. Hiatt was with Phillips Petroleum Co. for 25 years before joining PNW.

M. S. UMBENHAUER has been appointed manager of power plant design for the Fluor Corp. Ltd., Los Angeles.

L. J. MORRIS has been appointed assistatnt district manager at Pittsburgh for Tube Turns, succeeding W. C. ROBINSON, who was recently made an assistant sales manager and is located in

a precision instrument

H & M Pipe Cutting and Beveling Machines are designed and manufactured to high engineering standards. Close tolerances in gear design consistently give cleaner, more accurate cuts, yet the H & M is rugged and will withstand years of tough field use.

for pipe cutting and beveling

A complete line of beveling machines is available from H & M. The #1 machine will cut and bevel pipe as small as 4", the #5 machine will handle a diameter of 36". Once in place the entire 360° cut can be made in a matter of minutes with an effortless turn of the hand crank.

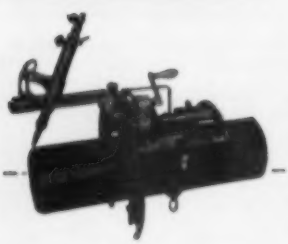
and

now lightest in its class

A new metal manufacturing process has recently made the H & M the lightest beveler in its class . . . has actually reduced the weights of the number 3, 4, and 5 machines by 40%. Think of what this means in the field—new lightness without any loss of durability.

gives you the most for your money

Point for point the H & M gives you more. It is actually possible to save one-half your labor and gas cost by using the H & M Pipe Cutting and Beveling Machine. Attachments are available for out-of-round and shape cutting. For more information, write H & M.



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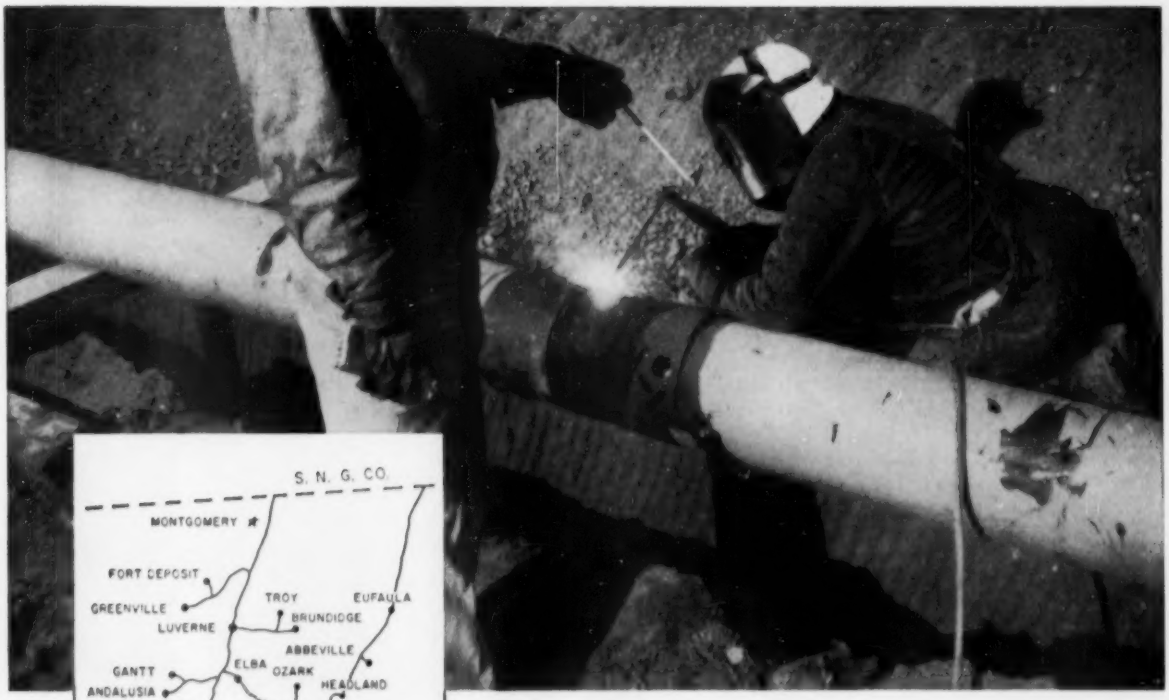

ENTIRE SOUTHEAST ALABAMA GAS DISTRICT SERVED BY

22,000 tons of NATIONAL SEAMLESS Line Pipe

The Southeast Alabama Gas District, consisting of 24 communities, will be served by a 330-mile "U" shaped system of USS National Seamless Line Pipe, designed by Goodwin Engineers, Inc., of Birmingham, Alabama.

The new main line ties into Southern Natural Gas Company's line approximately 12 miles south of Montgomery. It runs south to Brantley, then turns eastward at Andalusia and continues through Enterprise to Dothan. From Dothan it runs north and ties back into Southern Natural's line a few miles south of Opelika, Alabama.

The total 22,000 tons of pipe were made up of 6⅝" O.D., 8⅝" O.D. and 10¾" O.D. National Seamless. It was transported to the installation site by both barge and rail from plants in Ohio and Pennsylvania.

USS National Seamless Pipe is chosen consistently for the most challenging of cross-country pipeline jobs. Engineers know from past successes, like the "Big Inch" and the Straits of Mackinac crossing, that the best line installations are accomplished with National Seamless. Its high strength, complete uniformity, and a flexibility that lets it absorb ground pressures and bending stresses keep it trouble-free, even under the most punishing conditions.

IN GAS LINES TOO . . . SEAMLESS DOES IT BETTER

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

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USS

National Seamless Pipe and Tubes

Where Welding Is Welding

UNITED STATES STEEL

pipeline people • *Cont'd.*

the company's eastern division. T. T. THOMPSON has been added to Tube Turns' sales staff at Pittsburgh.

G. T. KOCH, present superintendent of transmission for Panhandle Eastern Pipe Line Co., Kansas City, Mo., has been put in charge of the newly formed operations research department. As a result, F. J. MCELHATTON will assume the job of superintendent of transmission. Succeeding him as superintendent of compressor stations is K. E. KALEN.

E. CLYDE MCGRAW, who served as vice president of operations during the five and a half years that Transcontinental Gas Pipe Line Corp. grew from a construction project into a $300 million operating pipeline, has been named executive vice president of the company.

GEORGE R. GALBRAITH has been named assistant vice president of the Walworth Co., where he will be in charge of coordinating Walworth sales development work by industries and products. He will continue to have charge of Walworth marine sales and specialty products.

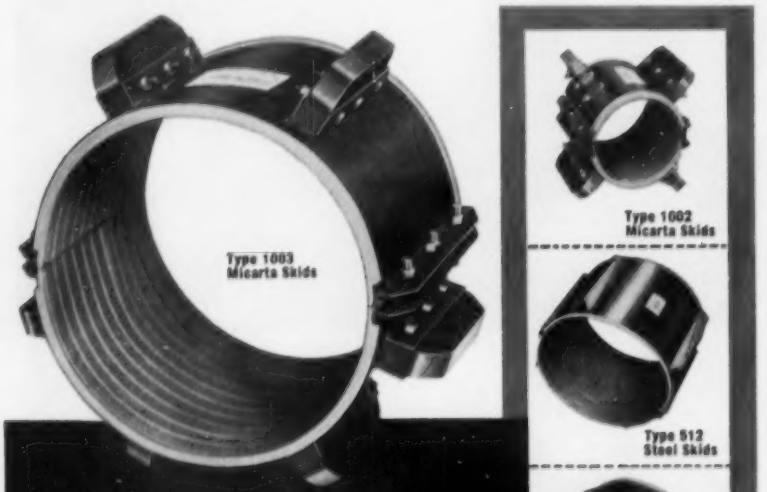
GORDON LEFEBVRE, formerly president of Cooper-Bessemer Corp., has joined Clark Bros. Co., Olean, N. Y., in an executive advisory capacity. The company has also appointed ROBERT R. MCCARTNEY as vice president in charge of overseas operations. He will headquarter in New York.

G. Lefebvre

R. R. McCartney

Clark Bros.

J. E. HIMMELRICH has been reassigned by the Protective Coatings division of Pittsburgh Coke & Chemical Co. to the Tulsa office, where he will represent the division in Oklahoma, Kansas, Nebraska, and Colorado. M. P. ELLIS has moved to the Pittsburgh office, succeeding Mr. Himmelrich, and will cover a territory consisting of Ohio, Kentucky, West Virginia, and western Pennsylvania.



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Pipeline Spacers can offer!

These Plico features*... service-proven by years of major transmission line usage... are your assurance of quality and dependability.

- Ribbed Neoprene liner assures control and prevention of coating cold-flow, and provides high electrical insulation.
- Extra-heavy-gauge metal construction for durability and long life expectancy.
- High-compression solid micarta skids assure exceptional shock resistance and provide double electrical insulation.

*Patents pending and applied for.

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PLICO TRADE MARK

GAS progress reports

NEW CONSTRUCTION PLANNED

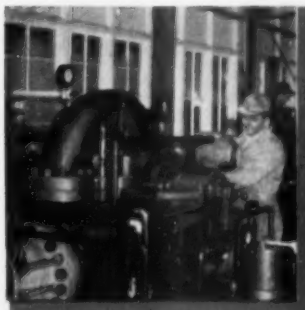
SOUTHERN CALIFORNIA and SOUTHERN COUNTIES GAS CO.S, Los Angeles. To build 236-mile, 30-in. line from Newhall, Calif. to Topock, Ariz. on Colorado river to meet El Paso Natural line from San Juan and Permian basins. Also three 1760-hp compressors at Topock.

TEXAS EASTERN TRANSMISSION CORP. and TEXAS EASTERN PENN-JERSEY TRANSMISSION CORP., Shreveport. Dockets G-9784-9787 for 422-mile, 30-in. line from Rio Grande river at McAllen, Texas, near Mexican border to transport imported gas to Vidor, Texas compressor station; approximately 530-mile, 30-in. loops along existing system between Kosciusko, Miss. and Uniontown, Pa.; 45 miles of 24-in. from connection with facilities near Provident City, Texas to new 422-milel ine in Matagorda City, Texas; 135 miles of supply and sales laterals; 5 new compressor stations totaling 50,000 hp; and 20,780 hp additions at existing stations.

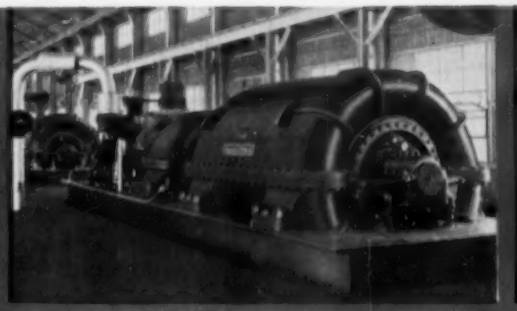
more than 325,000 horsepower of

I-R CENTRIFUGAL COMPRESSORS

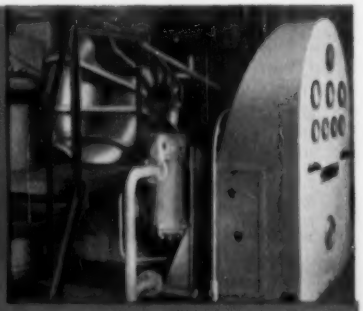
for NATURAL GAS SERVICE



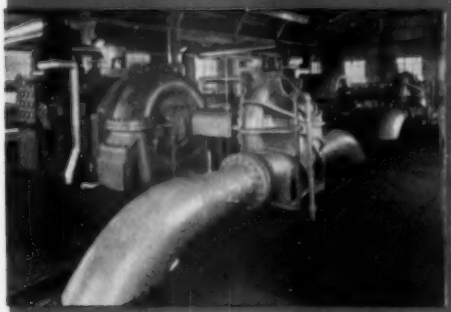
I-R centrifugal pipe-line compressor — 1250 hp, 3600 rpm, 750 psig discharge pressure.



Two 4,200 hp I-R centrifugal compressors, each handling 38,600 cfm of casing-head gas at 9.74 psig intake and 36.8 psig discharge.

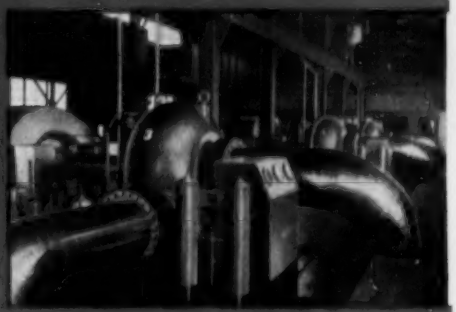


I-R centrifugal compressor boosting natural gas from 613 to 683 psig in pipe-line service.



Steam-turbine-driven I-R centrifugal gas compressors — 470 to 800 psig in 3 stages.

Ten I-R centrifugal compressors, boosting natural gas to 2,000 psig in 7 stages of compression for repressuring service.



Three of 8 I-R centrifugal pipe-line compressors with gas-turbine drive — 5000 HP, 800 psig discharge.

This experience means LONG-RANGE SAVINGS in modern pipe-line service

FROM THE VERY first pipe-line installation, Ingersoll-Rand has pioneered in the development of centrifugal gas compressors for higher and higher capacities and pressures. Every step of the way, dependability of performance has been a prime consideration in every detail of design and construction. This is why more I-R centrifugal compressors have been sold for natural gas service than any other make — a total exceeding 325,000 hp for this service alone. Backed by such long and successful experience, the modern I-R centrifugal gas compressor is your best assurance of trouble-free performance and long-range economy.

Ask your I-R representative for the complete, cost-saving story on centrifugal compressors for every service.

I-R *"FIRSTS"* in Centrifugal Gas Compressor History

FIRST **Centrifugal Pipe-Line Compressor**

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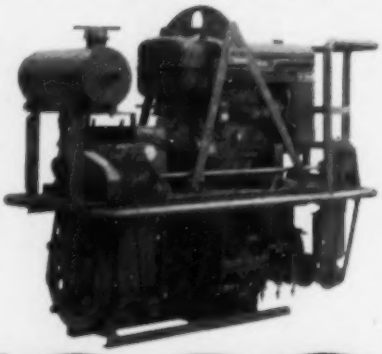
CROSE LINE TRAVELING PIPE CLEANING AND PRIMING MACHINE

This versatile pipe cleaning and priming machine can be used for line traveling operation or with stationary base (shown at right) for yard cleaning and priming—either way it is better built and more efficient to give you faster, trouble-free service. Crose cleaning and priming machines are available for all sizes of pipe including 36"



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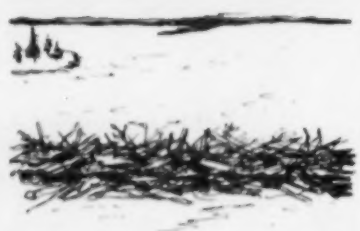

progress reports • *Cont'd.*

CURRENT CONSTRUCTION

AMERICAN LOUISIANA PIPE LINE CO., Detroit. Docket G-2306 to construct 1289 miles of line—30-in. from North Tepetate, Acadia parish, La., to connect with Michigan Consolidated facilities near Detroit; 24-in. to feed into 30-in. line in Louisiana, also three 10,000-hp compressor stations. Not included is the 117-mile, 22-in. line to extend from Payne, Ohio, to Bridgman, Mich., to connection with Michigan Wisconsin Pipe Line Co. Brown & Root has laid 57 miles, Houston Contracting 142 miles, H. C. Price 156 miles. All major river crossings are complete with exception of Tennessee, which is 60% complete. Completion is scheduled for June 1956 and project is on schedule.

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 - (1956 program) 239 miles of 22-in. line from Laramie, Wyo. to connection with proposed Pacific Northwest Pipeline Corp. line at Green River, Wyo.; with 4400-hp compressor station near Green River.

PACIFIC NORTHWEST PIPLINE CORP., Houston. Dockets G-1429 and 8932 et al for 1487 miles mainline; 443 miles of spur and lateral lines; and 13 mainline compressor stations totaling 83,500 hp and 2 booster stations totaling 4620 hp, to extend from Ignacio, Colo., in the San Juan basin, to Sumas, Wash. (Canadian border). Fish Northwest Constructors Inc., builders of the line, have let contracts to River Construction Corp., R. H. Fulton & Co., Associated Pipeline Contractors, A. J. Curtis Construction Co., B. & M. Construction Co., Midwestern Constructors Inc., H. B. Zachry Co., and Fulghum Construction Co. for first 1061 miles. Completion scheduled for fall of '56. As of Jan. 1, about 691 miles of mainline and 163 miles of gathering and lateral lines had been lowered in.

TENNESSEE GAS TRANSMISSION CO., Houston. Dockets G-2310, G-2330 and G-2331. Construction is underway at Morehead, Ky. on new compressor stations. Balance of project completed.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503 for 377 miles of line, 91,400 hp in new compressor stations, and 36,020 hp additions at existing stations—all to be located in Texas, Louisiana, Mississippi, Tennessee, Kentucky, Ohio, Pennsylvania, and Alabama. Compressor stations remain to be completed this winter.

UNITED GAS PIPE LINE CO., Shreveport. Docket G-8230 for 62 miles of line in Mississippi, Alabama, and Florida; 21-mile, 20-in. loop serving Pensacola 90% completed by Western Pipe Line Inc.; 7.3-mile line 65% completed by Berry Construction Co. Additions to compressor stations 80% completed by Joe R. Turner.

WESTCOAST TRANSMISSION CO. LTD., Calgary. To build 650-mile, 30-in. line from Peace river area to near Vancouver, B. C., to connect with line of Pacific Northwest Pipeline Corp., to transport 370 MMcf daily, of which 300 MMcf is to be delivered to PNW. Work has commenced on all four sections between Peace river and International Border.

APPROVED

EL PASO (TEXAS) NATURAL GAS CO. To build 413-mile, 34-in. loop line from San Juan basin to a point on California-Arizona border near Topock, Ariz., to increase supplies to existing customers.

A NEW SERVICE— ASK US ABOUT ON-THE-JOB MANUFACTURING OF CONCRETE RIVER WEIGHTS.

One of the many Edwards Concrete River Weights installations on Texas-Illinois Natural Gas Pipeline.

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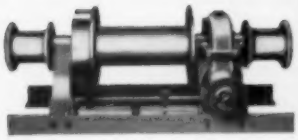

This contractor's truck mounts a Model 23 Tulsa Winch. The earth auger is powered forward with a Model 19 Tulsa Winch.

Contractors everywhere choose Tulsa Winch to lighten their equipment-moving jobs. Tulsa Winches are available in 28 models, in capacities from 6,500 to 80,000 lbs., for every model and make of truck or crawler tractor.

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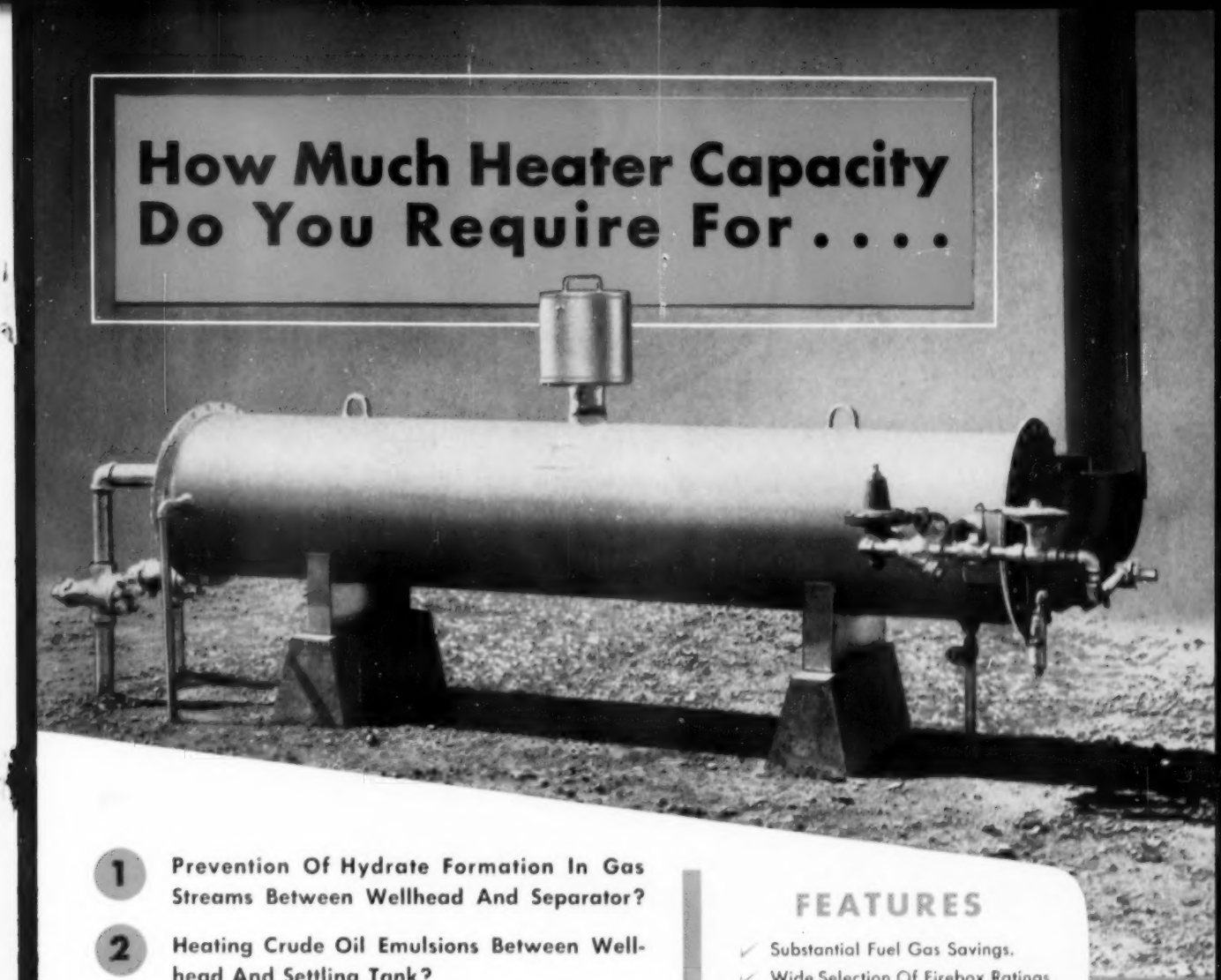

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SPRAGUE DIAPHRAGMS

Formed from a solid piece of the finest quality lambskin, specially tanned, vacuum oiled, cemented and tied to metal flanged rings, Sprague Diaphragms retain their tightness and flexibility for continuous low differential operation. By using genuine Sprague parts you reduce maintenance costs and keep the original equipment efficiency that Sprague builds into its products, thus assuring more profitable operation.

THE *Sprague* METER COMPANY

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